# Human Box Plot

## Box and Whiskers Plots

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| **Grade Level** | 6th – 8th Grade | **Time Frame** | 1-2 class period(s) |
| **Subject** | Mathematics | **Duration** | 60 minutes |

## Essential Question

How and for what types of data might a box and whisker plot be useful when displaying data? What data points are unclear when using a box and whisker plots?

## Summary

Throughout this activity and lesson, the teacher will help facilitate and guide student connections between prior knowledge of mathematical concepts and new knowledge. This lesson will activate student prior knowledge and elicit students to begin creating their own questions about box and whisker plots.

## Snapshot

### Engage

Students use their birthdays and a number line to construct a human dot plot by applying previous knowledge and then discuss other ways they could display their data from the dot plot.

### Explore

Students learn how to transform data sets (their dot plot) into a new type of graph by applying knowledge of dot plots, minimum value, maximum value, and median. Students discover the fundamentals of box and whisker plots through their active participation in creating a human box and whisker plot. Student then draw and record the final result in their notebooks.

### Explain

Students explain how the data is dispersed within the plot/graph. Also, students describe how to construct box and whisker plots from a set of data.

### Extend

Students construct their own box and whisker plots from different data sources (either provided by the teacher or researched by the student). Some extra extensions are included to modify for 7th and 8th graders.

### Evaluate

Students reflect and detail the key components of constructing a box and whisker plot. They also describe how data is displayed (quartiles) and what information can be easily gathered from a box and whisker plot (medians, minimum/maximum value, spread of the data, etc.).

## Standards

*Oklahoma Academic Standards for Mathematics (Grade 6)*

**6.D.1.1:** Calculate the mean, median, and mode for a set of real-world data.
**6.D.1.2:** Explain and justify which measure of central tendency (mean, median, or mode) would provide the most descriptive information for a given set of data.
**6.D.1.3:** Create and analyze box and whisker plots observing how each segment contains one quarter of the data.

*Oklahoma Academic Standards for Mathematics (Grade 6)*

**7.D.1.1:** Design simple experiments, collect data and calculate measures of central tendency (mean, median, and mode) and spread (range). Use these quantities to draw conclusions about the data collected and make predictions.
**7.D.1.2:** Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology.

*Oklahoma Academic Standards for Mathematics (Grade 6)*

**PA.D.1.1:** Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet and use a calculator to examine this impact.
**PA.D.1.2:** Explain how outliers affect measures of central tendency.
**PA.D.1.3:** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels and units.

## Attachments

- Explaining Box and Whisker Plots - Spanish.docx
- Explaining Box and Whisker Plots - Spanish.pdf
- Explaining Box and Whisker Plots.docx
- Explaining Box and Whisker Plots.pdf
- Human Box Plot Data Sets - Spanish.xlsx
- Human Box Plot Data Sets.xlsx
- Human Box Plot Extend Activity Grade 6 - Spanish.docx
- Human Box Plot Extend Activity Grade 6 - Spanish.pdf
- Human Box Plot Extend Activity Grade 6.docx
- Human Box Plot Extend Activity Grade 6.pdf
- Human Box Plot Extend Activity Grade 7 - Spanish.docx
- Human Box Plot Extend Activity Grade 7 - Spanish.pdf
- Human Box Plot Extend Activity Grade 7.docx
- Human Box Plot Extend Activity Grade 7.pdf
- Human Box Plot Extend Activity Grade 8 - Spanish.docx
- Human Box Plot Extend Activity Grade 8 - Spanish.pdf
- Human Box Plot Extend Activity Grade 8.docx
- Human Box Plot Extend Activity Grade 8.pdf

## Materials

- Sticky notes to create a number line, evenly spaced and numbered from 0–31
- Five mini flags or another item to visually indicate five specific points on the Human Box and Whisker Plot
- Bubble wrap (or any other wide material, like butcher paper). Length is dependent upon the group size and spacing on the number line.
- Two calculator tape rolls (or any other thin material like yarn or ribbon). Length is dependent upon the

group size and spacing on the number line.

- Student notebooks for drawing graphs and record keeping
- Pencils (one for each student)
- Excel spreadsheet or TI-nSprire calculator
- Paper
- Rulers
- Colored pencils or markers

# Engage

### Teacher's Note: Setting Up The Lesson

To set up the lesson, you will first need 31 sticky notes. Each sticky note needs to contain one number, starting with 1 and continuing consecutively up to 31. Evenly space each note on the floor along one side of your classroom. This will serve as a large number line for students to complete the Engage portion of this lesson.

Begin by asking students to recall their birthday. They can even share their birthday with their neighbor.

Ask students to find the sticky note along the wall that corresponds to the day of the month on which they were born (1-31). There's no need to worry about the month or year.

### Teacher's Note: What If We Have The Same Birthday?

This is great news! Not only do you share a birthday, but you also share sticky note. Ask whoever is oldest to be in the front, and the younger students can line up behind them.

Now that everyone has found a space on the number line, it is time to do some statistical reasoning! Share with students that by lining up in front of the number line they have created something in statistics called a "dot plot."

Next, students will engage with their peers to answer some simple questions about the dot plot. Pose the following questions to the whole class (who are still lined up on their sticky notes):

1. "What do you notice about our dot plot?" Ask students to think for a moment about the way their data is displayed. Next, have them talk to a peer about what they notice. Then, solicit a few responses from the class.

2. "What other ways could you imagine displaying our birthday data?" Again, ask students to think about their response independently for a moment, then pair up with a neighbor, and solicit a few responses from the class.

# Explore

**Teacher's Note: Exploring As A Whole Class**

This exploration engages students in transforming their dot plot into a box and whiskers plot. It is to be done as a whole class. You'll want to keep the momentum moving in this portion of the lesson in order to keep students focused and engaged.

First, share with students that together they are going to construct a box and whiskers plot using statistical terminology. They are going to do so as a whole class, but you will help guide them.

In a similar fashion as in the Engage section above, ask students to think about the following terms: maximum, minimum, median, and quartile. Ask students to pair up and discuss what they think each term means. Solicit responses from the class and help students clarify misconceptions they may have.

Based on the definitions created for the terms above, ask students to determine what they believe are the minimum and maximum values for their dot plot. Hand the student(s) standing on the maximum and minimum values a flag to mark these. *(Note: These will be the least and greatest values, if students are having a difficult time articulating them.)*

Next, ask students to think about what they believe is the median value for their dot plot and how they would go about finding it. Once students think for a minute, have them pair with a partner to discuss their answer. Solicit a few responses from the class and go about finding the median value based on their suggestions. You may want to try a couple of different ways to show multiple solutions, assuming time permits.

Mark the median value with another flag. The median marks the 2nd quartile and will help us determine the other quartiles. Ask students to think about how they may go about finding the four quartiles now that they know the median.

Use student responses to determine all four quartiles. Here's a brief overview of how to do it in order to help guide students:

1. After you identify the median of the whole data set, use this value as the minimum of the upper half of your data set. Find the median of the upper half of the data set.
2. Find the median of the lower half of the data set. The median of the entire data set will serve as the maximum for this calculation.
3. Label the four points (quartiles) you have: Q1—the median of the lower half; Q2—the median of entire data; Q3—the median of the upper half; and Q4—the maximum of data set.

Mark Q1 and Q3 with flags. Now you should have five marked data points:

1. Minimum
2. Q1
3. Median (Q2)
4. Q3
5. Maximum (Q4)

Finally, to complete the box and whisker plot, we'll need to use bubble wrap (or any other wide material, such as butcher paper) and calculator tape. Use the bubble wrap to designate the distance between Q1 and Q3. Ask the person standing at Q1 to hold the end of the bubble wrap and unravel it until you get to Q3. Ask the person standing at Q3 to hold their end. The calculator table will extend in two places: From the minimum to Q1 and also from Q3 to the maximum.

Ask students to set their materials down, step in front of the box and whisker plot that has been created, and note what they see.

# Explain

Have students return to their desks and distribute the "Explaining Box and Whisker Plots" handout.

Working with a partner, ask students to share their observations about the box and whisker plot they helped create in the class. Ask students to identify and define the terms as directed in the handout: quartiles, median, maximum, minimum, box, and whiskers.

# Extend

In the Extend section, students will further explore different data sets. To do this, distribute the attached Extend Handout to each pair of students. Each Extend Handout is tailored to the grade level indicated in the file name. The instructions at the top of the handout indicate that students will either be generating a data set of their own or they will be given one. This is completely up to your discretion as a teacher. If you choose to have students create their own, some ideas are listed below. If you would like to use some that are already made, you can find a Google Sheet with prepared data sets here and attached. The full URL for the link is listed in the resources below.

### Teacher's Note: Ideas For Data Sets

Find out what your students are interested in. They may have interests in music, sports, or other areas that can lend themselves nicely to data collection. Here are a few examples. Students could plot the number of three-pointers made for each NBA team. That would give them approximately 30 data points. Students could also look at the number of concerts at Madison Square Garden over the past 50 years. That would provide 50 data points and might show trends in a population's disposable income. Students could look at the number of incarcerations over the past 30 years to see trends in data. Maybe students keep a food log of how many calories they eat every day. Over the course of month, this could provide some insightful data into their personal health. Students could also look up 30 different schools to determine their ACT or SAT requirements. This might provide interesting multi-modal data while also helping them set goals for their future.

### Teacher's Note: What To Do When Generating A Data Set

Ask students to record or copy the data they obtain into a spreadsheet using Excel, Google Sheets, or another application your school can access. Make sure that the data are comprised of at least 30 points and is related to students' interests.

For constructing graphs in the Extend exercises, you can have students use Excel, a TI-nSpire calculator, or they can do so by hand. If using Excel or TI-nSpire, be sure to practice in advance so that you are prepared to help resolve any challenges students may encounter. If you are asking students to create their graphs by hand, make sure they have rulers, paper, and bright color options to make their creations artistic, informational, and accurate. Both methods, digital and manual, have many positives, and students can easily display their work for others to see.

### Teacher's Note: Optional Eighth Grade Activities

In the Grade Eight Extend Handout, questions 11–15 are optional but may provide more helpful insights. Using Excel and/or TI-nSpire may be especially helpful, as well.

# Evaluate

For the lesson evaluation, guide students in a Gallery Walk instructional strategy.

Distribute extra-large sticky notes, butcher paper, or poster paper to each pair of students.

Explain to students that they need to create a visual representation of their findings, such as a graph or other visual image that accurately and adequately expresses their data.

Give students 10–15 minutes to create their poster, then have them attach it to a wall and stand near it.

Distribute three or four sticky notes to each student. Explain to students that they can use these to write down questions and comments to place on their peers' posters.

Have students freely move about the room to explore other students' work. As they do, they will leave their sticky note comments, questions, or suggestions on the other posters. After everyone has completed the Gallery Walk, students may return to their own poster and read the comments that were left.

## Resources


- K20 Center. (n.d.). Gallery walk / carousel. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505a54d
- K20 Center. (2019). Human Box Plot Data Sets. Retrieved from https://docs.google.com/spreadsheets/d/1Q_-l4gzXR4rOHq712WS6jrSo2vxZJ1MJVeYHnTaSv6I/edit#gid=0