Name: _____   Date: _____

Student Exploration: Box-and-Whisker Plots

Vocabulary: box-and-whisker plot, interquartile range, maximum, median, minimum, quartile

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Holly and Brian's social studies teacher gives them quizzes worth up to 20 points. Holly received the following scores: 5, 11, 17, 18, and 20. Brian's scores were 16, 16, 17, 19, and 19.

1. The **median** is the middle value of a data set. What is the median of each set of scores?

   Holly's median: _____   Brian's median: _____

2. Aside from having the same median, are the data sets very similar? _____

   Explain. _____

Gizmo Warm-up
Both Brian and Holly had the same median score, but in other ways their scores were very different. While Brian's scores were very consistent, Holly's scores were all over the place.

One way to visualize the "spread" of a data set is to use a **box-and-whisker plot**. You can explore these graphs with the *Box-and-Whisker Plot* Gizmo. To begin, check that **Link plots** is selected. The data set shown in the dot plot should be 2, 7, 10, 13, and 18.
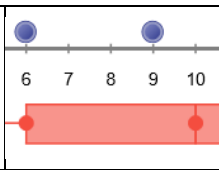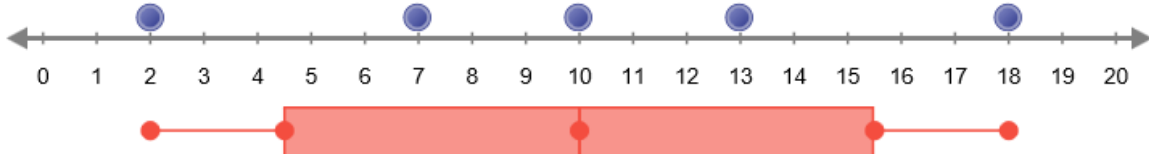

1. The **minimum**, or lowest value, of the data set is 2. Move the leftmost blue dot back and forth. How does this relate to the position of the leftmost point of the box-and-whisker plot?

   _____

2. How does the position of the **maximum** (highest value) of the data set affect the box-and-whisker plot? _____

3. Move the middle blue point (the median) back and forth. How does this affect the box-and-whisker plot? _____

| **Activity A:**

Creating box-and-whisker plots | <u>Get the Gizmo ready</u>:

• Check that **Link plots** is selected. Click **Clear**.
• Drag points to 2, 6, 9, 11, 14, and 18 on the line plot above the box-and-whisker plot. | |

1. A box-and-whisker plot of a data set contains five key values. So far, you know what three of these points represent: the minimum, the median, and the maximum.

Minimum   **Median**   **Maximum**
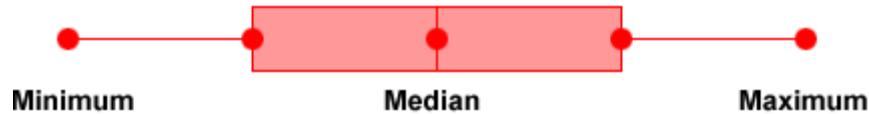
   A. What is the median of the data set, 2, 6, 9, 11, 14, 18? _____

   (Hint: When there is an even number of values in the data set, the median is the mean of the two middle values. To find the mean, add the values and divide by 2.)

   B. What are the set's minimum and maximum values? Min. _____ Max. _____

2. A box-and-whisker plot divides the data into four quarters. The boundaries of these segments are called **quartiles**. The first quartile (Q_1) is greater than about 25%, or one quarter of the data. The median is the second quartile (Q_2), and is greater than about 50% of the data. The third quartile (Q_3) is greater than about 75% of the data.

   A. In the data set given above, how many data points are to the left of Q_2? _____

   B. What are the values of these points? _____

   C. What is the median of these values? _____

   This is the first quartile, Q_1. Notice that it forms the left side of the "box."

   D. How many data points are to the right of Q_2? _____

   E. What are the values of these points? _____

   F. What is the median of these values? _____

   This is the third quartile, Q_3. It forms the right side of the "box."

3. Add a point at 10. The data set should now be 2, 6, 9, 10, 11, 14, and 18.

   Do the positions of Q_1 or Q_3 change? _____

   The new point, which is on Q_2, does not affect the other quartile values because only the points to the left and right of Q_2 are used to find Q_1 and Q_3.

(Activity A continued on next page)

Activity A (continued from previous page)

4. Deselect **Link plots** and click **New**. In this setting, the box-and-whisker plot is not automatically linked to the line plot. This allows you to manipulate the points in the box-and-whisker plot to match the data.

    A. What is the new data set? _____

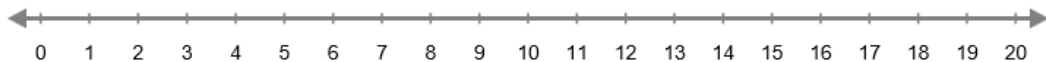   B. What are the minimum and maximum of this set? Min. _____   Max. _____

    C. What is the median of this data set? _____

    D. What is the median of the terms to the left of Q_2? _____

    E. What is the median of the terms to the right of Q_2? _____

    F. In the Gizmo, create a box-and-whisker plot for the data set by dragging the five red points to the correct values. When you are done, select **Check plots**. If necessary, adjust your plot until your box-and-whisker plot matches the line plot.

    G. In the space below the number line, draw the box-and-whisker plot for this data set. Label the values of the five key values: **Min.**, Q_1, Q_2, Q_3, and **Max.**

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   0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 20
```
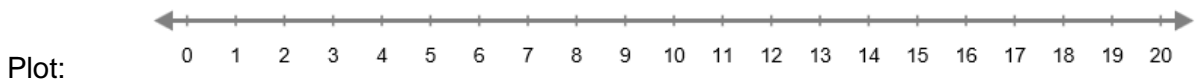
    H. The **interquartile range** (IQR) is the difference between the first and third quartiles: IQR = $Q_3 - Q_1$. In other words, it is the width of the box in the box-and-whisker plot.

   What is the interquartile range of this data set? _____

5. Deselect **Check plots**, and click **New**. In the space below, record the data set and create a corresponding box-and-whisker plot. Use the Gizmo to check your work.

Data set: _____

```
◄──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──►
   0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 20
```
Plot:

Activity B:	Get the Gizmo ready:	
Interpreting box-and-whisker plots	• Click **Clear**. • Check that **Link plots** is *not* selected.	

1. Use the Gizmo to create the box-and-whisker plot shown below. Then, create a data set that matches the plot. The data set should have 10 values. Use the Gizmo to check your work.
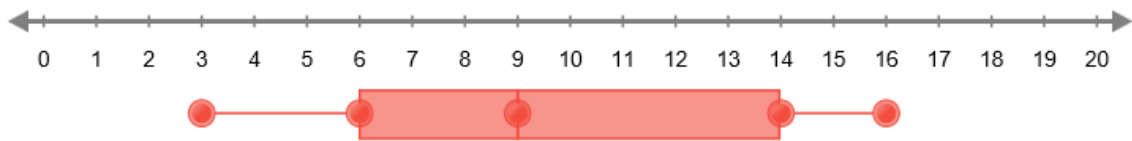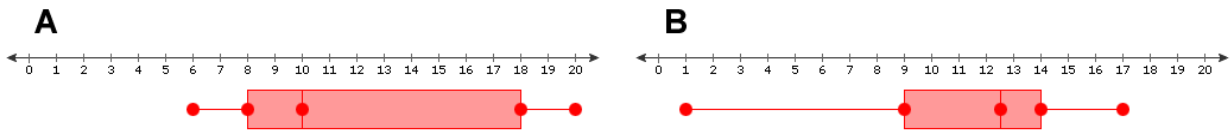

   Data set: _____

   Challenge: Create a second data set that also matches the given box-and-whisker plot. This data set should have 13 values. Use the Gizmo to check your work.

   Data set: _____

2. Two box-and-whisker plots are shown below. Each plot represents a data set with 6 items.

A

B

   A. Which plot shows data with a greater range? _____

   B. Which plot shows a greater interquartile range? _____

   C. In your opinion, which plot shows data that is more spread out? _____

   Explain your answer. _____

   _____

   D. Challenge: The *mean* of a data set is equal to the sum of all the values in the data set divided by the number of values.

   Which plot shows data in which the mean is likely greater than the median? _____

   Explain why you think so. _____

   _____

   _____