Overview and Connection to Culminating Project

Students have two opportunities to create a five-number summary and box plot from a data set, thus giving them the opportunity to develop deeper conceptual understanding and stronger procedural fluency—they will "get" the reasons, and become stronger at creating the visual displays. The use of technology in creating box plots is not discouraged, but students should also have the chance to build them by hand to gain fluency in the skill of partitioning a number line consistently and gain understanding of what the visual display represents. When groups have a pair of box plots from different data sets that answer the same question (e.g., How many pets do you have in your home?) that are accurately graphed **using the same scale**, they will be able to compare and analyze across two data sets, make observations about what the statistics are, and draw inferences about what they mean. This will set them up for Learning Task 4: expanding out to state, national, or international data sets.

Learning Objectives

Students will be able to

- Calculate range, five-number summaries, and interquartile range.
- Describe, interpret, and draw conclusions from the variability of a data set.
- Represent data using box plots.
- Understand that data sets can have similar centers but different variability.
- Create data sets that meet specific constraints.
- Understand ways in which measures change when new data is added to a set.
- Determine which statistical measures are best used for summarizing different data sets.

Driving Question

• How can variability be used to summarize data?

Assessment

Check for Understanding • Interpret Box Plots

Timeline

- Lesson 1 Build a Box Plot: Part I
- Lesson 2 Build a Box Plot: Part II
- Lesson 3 Sleep Variability
- Lesson 4 Invent Data Sets
- Lesson 5 Compare Representations
- Check for Understanding Interpret Box Plots

Materials, Supplies, and Technology

- Computers with internet access if available
- Chart paper
- Sticky notes
- Index cards
- Graphing calculators or graphing/statistical software
- Graph paper
- Chart paper
- Markers
- You may wish to make several copies of the dot plots that students created in Learning Task 1 so students can draft box plots on top of the existing scale and plotted data set. This will help students to bridge from a representation of every data point to an abstracted version that includes only the *five number summary*.
- Sticky notes with one piece of data from a data set on each (you may want to use the data from one of the "Who Are We?" survey questions)
- Copies of Check for Understanding Interpret Box Plots (see Handouts and Assessments)

Resources

- <u>http://www.huffingtonpost.com/vincent-marrero/i-am-trayvon-martin_b_1376160.html</u> (an example of using audio interviews to writefor an "article)
- <u>www.weebly.com</u> (website-building resource)
- <u>http://www.law.yale.edu/admissions/profile.htm</u> (example of a class profile)
- <u>http://onlinemba.unc.edu/admissions/class-profile/</u> (example of a class profile)
- <u>http://www.amstat.org/censusatschool/about.cfm</u> (online source of data for students to research and compare their Class Profile with city, state, and national data; they do this in Learning Task 4)
- Stat Trek: Statistics and Probability Dictionary (range)
- <u>Stat Trek: Statistics and Probability Dictionary</u> (interquartile range)
- Math Is Fun (mean and absolute deviation)

BUILD A BOX PLOT: PART I

WARM-UP

Analyze Data

• Have students work on the warm-up activity in their Student Edition.



• Remind students to update their Sleep Log.

LESSON 1 • BUILD A BOX PLOT: PART I

- Explain that the dot plots from the warm-up show that even if two data sets have a similar center, there might be other ways in which they differ. If possible, use examples from the class's dot plots to show more examples of this.
- Using the warm-up and graphics like Central Tendency and Variability, explain that in addition to center, mathematicians also describe the variability of a data set to summarize large sets of data (like in a class profile).

PROJECT ACTIVITY

Build a Box Plot

• Tell students that one way to analyze the variability of a data set is to create a five-number summary and a box plot. Give students chart paper and sticky notes or index cards. Have them use the same data they used for their dot plot from Learning Task 1 to make a five-number summary and a box plot. Students will have a chance to finish their box plots in the next lesson.

Use the same data your team used for your dot plot from the "Who Are We?" survey to work on this activity.

- 1. Put each piece of data on a separate sticky note.
- 2. Order your sticky notes from least to greatest on chart paper.
- 3. On the back of your chart paper, create a five-number summary for your data. Show how you did this using your sticky notes.

Your five-number summary must include:

minimum, maximum, median, 1st quartile, 3rd quartile

minimum 1st q	uartile ı	median	3rd quart	tile max	imum
25%	25%	25	5%	25%	

- 4. Use your minimum and your maximum to create a number line that you can plot all your data on.
- 5. Use your five-number summary and your number line to create a box plot. You will have a chance to finish your box plot in the next lesson.
- 6. Keep your sticky notes to answer questions about your box plot when you are finished.
 - STUDENT EDITION
- Update the Statistics Word Wall to include *five-number summary, minimum, maximum, quartile, range, variability,* and *interquartile range* under the category of "Variability."



BUILD A BOX PLOT: PART II

WARM-UP

Physical Box Plot

- Create a large number line on a whiteboard or wall that is big enough for students to line up along.
- Give students sticky notes or index cards that each have a piece of data that would fit on this number line. (Data can be from one of the data sets from their survey questions.)
- Have students get up and sort themselves in order to figure out their five-number summary.
- Mark the boxes and whiskers on the large number line.
- Have students stand alongside the number line at the appropriate location so they can see how the data is spread out.
- As they stand along the number line, ask questions such as:
 - What is the range of this data?
 - What is the interquartile range of this data?
 - What fraction of the data occurs below or above the median?
 - What fraction of the data occurs within this whisker (point to one of the whiskers)?
 - Does this longer whisker represent more data than the shorter one?
- Have students evaluate or create claims about **half** of the data, **one-quarter** of the data, **three-quarters** of the data.
 - 1. Create a human box plot with your class following the instructions of your teacher.
 - 2. As you look at the box plot, answer these questions.
 - What is the range of this data?
 - What is the interquartile range of this data?
 - What fraction of the data occurs below or above the median?
 - What fraction of the data occurs within this whisker?
 - Does this longer whisker represent more data than the shorter one?
 - 3. Update your Sleep Log.

Remind students to update their Sleep Log.

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LESSON 2 • BUILD A BOX PLOT: PART II

PROJECT ACTIVITY

Continue Working on Box Plot

• Give students more time to finish or revise their box plot if needed.

Continue to work on the box plot you started in the previous lesson.

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- At the end of class, have students share and compare the strategies they used for making their box plot.
- Ask students to show what to do when there are an even number of data points in a set or in half a set.
- Also have students share what information their box plot **does** and **does not show** (average, number of observations, and so on).
- Ask questions such as:
 - What is the range of this data?
 - What is the interquartile range of this data?
 - What fraction of the data occurs below or above the median?
 - What fraction of the data occurs within this whisker (point to one of the whiskers)?
 - Does this longer whisker represent more data than the shorter one?
- Have students evaluate or create claims about **half** of the data, **one-quarter** of the data, **three-quarters** of the data.

Math Curricular Connections Suggestions

<u>Khan Academy: Box plots</u> <u>Learnzillion: Data distributions</u> <u>Learnzillion: Analyzing data</u> <u>NCTM Illuminations: Box Plot tool</u>



SLEEP VARIABILITY

WARM-UP

Interpret Box Plots

• Have students work on the warm-up activity in their Student Edition.

Students at another school are also tracking the number of hours of sleep they get each night. They recorded 41 responses (observations) for a particular school night. Three different groups made the box plots below using the exact same data.



• Remind students to update their Sleep Log.

LESSON 3 • SLEEP VARIABILITY

PROJECT ACTIVITY

Sleep Variability

• Have students use the sleep data set from the previous activity (or create a new data set for a different night) to complete this activity.

(Note: If students have more than 10 individual pieces of data in their Sleep Log, they can use their own data to show the variability of their sleep across time. Doing this may help to address the misconception that data sets must be about multiple people in order to have variability.)



- As students answer question 5, encourage them to address questions such as:
 - What fraction of the data occurs below or above the median?
 - What fraction of the data occurs within this whisker (point to a whisker)? Does the longer whisker represent more data than the shorter one?
- Have students evaluate or create claims about **half** of the data, **one-quarter** of the data, **three-quarters** of the data.

Math Curricular Connections Suggestions

<u>Khan Academy: Box plots</u> <u>Learnzillion: Data distributions</u> <u>Learnzillion: Analyzing data</u> <u>NCTM Illuminations: Box Plot tool</u>

INVENT DATA SETS

WARM-UP

Five-Number Summary

• Have students work on the warm-up activity in their Student Edition.



Remind students to update their Sleep Log.



LESSON 4 • INVENT DATA SETS

PROJECT ACTIVITY

Invent Data Sets

• Have students work on the TV-watching activity in their Student Edition.

..... In 2014, 30 sixth graders from across the country were asked, "How many hours of TV do you watch per week?" Here is the box plot of that data set.. **TV Watching** 16 20 24 8 12 28 Hours of TV per Week 1. Invent two sets of data that the box plot above could represent. Show the calculations for the five-number summary for both invented sets of data. Data Set 1 Data Set 2 Answers will vary. Answers will vary. 2. Explain your strategies for inventing your two data sets. Answers will vary. 3. What observations can you make about the difference between your two invented data sets? Data Set 1 Data Set 2 Answers will vary. Both

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Math Curricular Connections Suggestions

Engage NY: <u>Box plot activities</u> <u>Khan Academy: Box plots</u> <u>Learnzillion: Data distributions</u> <u>Learnzillion: Analyzing data</u> <u>NCTM Illuminations: Box Plot tool</u>



COMPARE REPRESENTATIONS

WARM-UP

Dot Plots to Box Plots

• Have students convert one of the dot plots from Learning Task 1 into a box plot. Then have them compare and contrast the two representations.

wo representations.		
Dot Plot	Box Plot	
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• Remind students to update their Sleep Log.

PROJECT ACTIVITY

Data Sets and Box Plots

- Have students continue to work on any unfinished activities.
 - Continue to work on the "Invent Data Sets" activity from the last lesson and on any other unfinished work.

STUDENT EDITION

Math Curricular Connections Suggestions

Engage NY Box plot activities Khan Academy: Box plots Learnzillion: Data distributions Learnzillion: Analyzing data NCTM Illuminations: Box Plot tool

LESSON 5 • COMPARE REPRESENTATIONS

CHECK FOR UNDERSTANDING

Interpret Box Plots

• Distribute the Learning Task 3 assessment—Check for Understanding • Interpret Box Plots.



HANDOUTS AND ASSESSMENTS