Splash! into Statistics – High School (Grades 9-12)

Introduction	In these activities, students will explore the data that they gathered with Splash! and apply it to various mathematical tasks.
Time	Approximately 90 minutes
Grade	9-12
Lesson Preparation	Students will have visited the Tsongas Industrial History Center to participate in the Power to Production program. Students gathered data from the waterwheel test on the Splash! app. The teacher should decide if the class will use the Sample Data spreadsheet (labeled data) or the Mystery Wheels spreadsheet (unlabeled data). Both files are available in .xlsx format with this lesson. Students can use either a graphing calculator or a computer to calculate.
Vocabulary	Mean Median Standard Deviation Interquartile Range
Anticipated Student Preconceptions/ Misconceptions	Students should know the definitions of the terms mean, median, standard deviation, and interquartile range. This lesson will review the use of these statistics in describing a data set. Students should have knowledge of different methods of representing data on a single variable.
Frameworks	Massachusetts Math Standards S-ID: Summarize, represent, and interpret data on a single count or measurement variable. 1. Represent data with plots on the real number line (dot plots, histograms, and box plots).⋆ 2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. ⋆ 3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). ⋆

⋆ Indicates modeling standard.

Guiding Question	How can we use various statistics to describe the behavior of wheel/ base combinations?
Objectives	Students will be able to: • Determine the mean, median, standard deviation and interquartile range for each of the eight data sets, using either Sample Data or Mystery Wheels spreadsheet. • Use the information from the Mystery Wheels spreadsheet and the data their class gathered at Splash! to determine which of the eight mystery wheels their assigned wheel matches to.
Activity	1. Group students in teams of three or four 2. Show the data gathered at the site using the Splash! app. Remind students of the different types of wheel and base combination (red is bucket, blue is paddle). 3. Assign each group one of the wheel/base combinations collected on the field trip. Provide students with either the Sample Data or Mystery Wheels spreadsheet. 4. If students are using the Sample Data sheet: • Students will determine the mean, median, mode, range and standard deviation for each set. • Students will determine if the data gathered on the field trip is outlier data, or if it is reasonable given other tests. 5. If students are using the Mystery Wheels sheet: • Students need to match their wheel/ base combination with one of the Mystery Wheels. • Students should be able to present their results to the class and justify their match using statistics.
Assessment	Assessment will be done through student presentations, either written or oral.
Differentiated Suggestions	Differentiation based on time: Use only the odd numbered columns (speed data), or only four of the eight wheel/ base combinations. The original excel file contains a teacher sheet with information about which data were collected from which wheel. For ELL students, consider providing sentence frames “I know _____ because _____.” “I agree with _____ because _____.” “I disagree with _____ because _____.”

Adapting the Activity for Other Grades	For students preparing for the MCAS test, the questions could be presented in a four part "long answer" style model, using only one of the sets of data. For example, given the column A data set a. Find the range of the data. b. Find the lower bound, median, upper bound of the data set. c. Create a box and whisker chart to represent the data set. d. The testers determined that the speed measurement of 15 was inaccurate. If this data point is removed, how would the box and whisker chart change? Other ideas include dividing students into teams of two or four students – one student or pair creates a line plot from one column of data, then challenges the other student or pair to find mean, median, mode and range from the line plot.

Sample Data

Bucket Base A Speed	Bucket Base A Strength	Bucket Base B Speed	Bucket Base B Strength	Bucket Base C Speed	Bucket Base C Strength	Bucket Base D Speed	Bucket Base D Strength	Paddle Base A Speed	Paddle Base A Strength	Paddle Base B Speed	Paddle Base B Strength	Paddle Base C Speed	Paddle Base C Strength	Paddle Base D Speed	Paddle Base D Strength
5	0	9.5	7	11	3	8	3	3.5	0	8	5	8.5	1	7.5	2
4	0	8	5	10	4	9		3	0	7	5	9	2	8	3
5	0	11	4	11	4	9	3	7	0	10	2	8	2	10	2
0	0	9	3	11	5	8	4	3	0	7	3	7	2	8	1
3	0	9	6	11	6	8	8	0	0	7	5	10	2	8	2
6	1	10	3	6	3	9	4	6	0	11	3	7	4	8	3
5	0	8	5	11	3	8	3	4	0	8	3	8	1	7	2
7	0	8	4	4	5	5	5	5	0	5	6	4	0	9	2
5	0	9	4	9	3	4	4	6	0	8	7	5	0	7	3
4	0	10	4	9	3	8	3	6	0	5	5	2	3	8	1
4	0	9	3	11	4	8	1	4	0	5	5	6	2	8	0
4	0	10	3	8	3	10	3	5	0	5	5	11	2	8	1
4	0	7	1	11	4	8	1	6	0	5	5	9	2	8	0
7	1	10	5	12	4	9	5	6	0	8	4	6	3	8	5
7	0	9	4	10	3	4	2	5	0	7	3	4	4	9	2
4	0	5	2	8	6	8	8	8	0	9	7	5	0	9	4
15	0	6	2	15	8	15	4	14	0	15	6	13	3	10	
6	0	9	4	12	7	7	4	8	0	7	5	5	2	9	3
8	0	9	4	16	8	5	2	7	0	8	6	11	3	7	6
6	1	5	2	13	6	5	2	7	1	7	2	8	2	8	2

Mystery Data

Wheel Base1 Speed	Wheel Base1 Strength	Wheel Base2 Speed	Wheel Base2 Strength	Wheel Base3 Speed	Wheel Base3 Strength	Wheel Base4 Speed	Wheel Base4 Strength	Wheel Base5 Speed	Wheel Base5 Strength	Wheel Base6 Speed	Wheel Base6 Strength	Wheel Base7 Speed	Wheel Base7 Strength	Wheel Base8 Speed	Wheel Base8 Strength
5	0	9.5	7	11	3	8	3	3.5	0	8	5	8.5	1	7.5	2
4	0	8	5	10	4	9		3	0	7	5	9	2	8	3
5	0	11	4	11	4	9	3	7	0	10	2	8	2	10	2
0	0	9	3	11	5	8	4	3	0	7	3	7	2	8	1
3	0	9	6	11	6	8	8	0	0	7	5	10	2	8	2
6	1	10	3	6	3	9	4	6	0	11	3	7	4	8	3
5	0	8	5	11	3	8	3	4	0	8	3	8	1	7	2
7	0	8	4	4	5	5	5	5	0	5	6	4	0	9	2
5	0	9	4	9	3	4	4	6	0	8	7	5	0	7	3
4	0	10	4	9	3	8	3	6	0	5	5	2	3	8	1
4	0	9	3	11	4	8	1	4	0	5	5	6	2	8	0
4	0	10	3	8	3	10	3	5	0	5	5	11	2	8	1
4	0	7	1	11	4	8	1	6	0	5	5	9	2	8	0
7	1	10	5	12	4	9	5	6	0	8	4	6	3	8	5
7	0	9	4	10	3	4	2	5	0	7	3	4	4	9	2
4	0	5	2	8	6	8	8	8	0	9	7	5	0	9	4
15	0	6	2	15	8	15	4	14	0	15	6	13	3	10	
6	0	9	4	12	7	7	4	8	0	7	5	5	2	9	3
8	0	9	4	16	8	5	2	7	0	8	6	11	3	7	6
6	1	5	2	13	6	5	2	7	1	7	2	8	2	8	2