FUN WITH STATISTICS IN MIDDLE SCHOOL
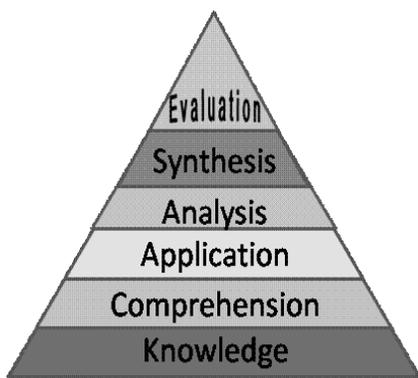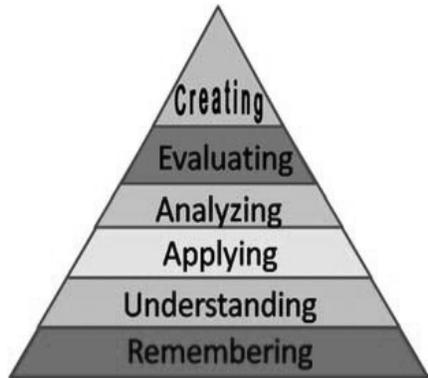
Presented by

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RIGOR: LEVELS OF THINKING

| Bloom's Taxonomy 1956 | Bloom's Taxonomy 1990s | Webb's Depth of Knowledge 2002 |

COGNITIVE DEMAND SPECTRUM

Memorization	Procedures without Connections	Procedures with Connections	Doing Mathematics
↓	↓	↓	↓
memorized procedures in routine ways	no understanding or meaning of concepts	understanding or meaning attached to concepts	engagement with concepts; tasks stimulate students to make connections to meanings, representations, and other mathematical ideas

MATHEMATICS TESTING SPECIFICATIONS

	DOK3	DOK4
CA Standards Test (CST)	**<2%**	**0%**
Smarter Balanced Assessment (SBAC)	**49%**	**21%**

NAME SCORES

1. Use the values below to determine your first name score.

    Example: JOEY → J + O + E + Y = 10 + 1 + 1 + 4 = 16

A = 1	E = 1	I = 1	M = 4	Q = 10	U = 2	Y = 4
B = 4	F = 4	J = 10	N = 2	R = 1	V = 5	Z = 10
C = 4	G = 3	K = 5	O = 1	S = 1	W = 4	
D = 2	H = 3	L = 2	P = 4	T = 1	X = 8	

    What is your name score? _____

2. In numerical order, list the first name scores of everyone in your class in the table below.

3. How many recorded name scores do you have? _____   We will refer to this value as the number of observations (n).

Finding the measures of center

4. Describe how to find the mean.

    Find the mean for this data set. _____

5. Describe how to find the median.

    Find the median for this data set. _____

NAME SCORES (Continued)

Finding the <u>measures of center (continued)</u>.

6. Describe how to find the mode.

    Find the mode(s) for this data set. _____

Finding <u>measures of spread (variability)</u> and the <u>five-number summary</u>.

7. Describe how to find the range.

    Find the range for this data set. _____

8. Describe how to find the five-number summary.

    List the five-number summary. (_____, _____, _____, _____, _____)
                                       min Q_1 med = Q_2 Q_3 max

9. Describe how to find the interquartile range (IQR).

    Find the IQR for this data set. _____

   What percent of all observations are between Q_1 and Q_3? _____

Summarizing <u>measures of center and spread (variability)</u>.

10. Which measure of center do you think best represents the middle of the name score data set? Explain.

11. Which measure of spread do you think best represents the variability in the name score data set? Explain.

DATA DISPLAYS OF NAME SCORES

Use the class name score data to create the following data displays.

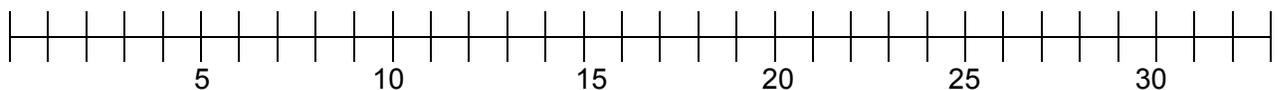1. Construct a dot plot of the class name score data. Extend the number line if necessary.

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         5          10          15          20          25          30
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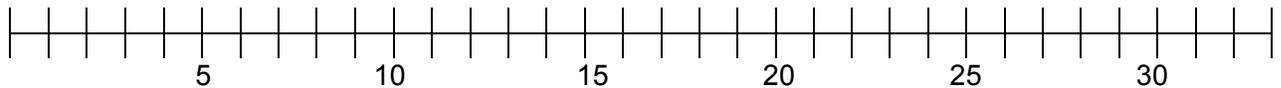
2. Construct a histogram of the class name score data. Extend the histogram if necessary. Be sure each interval is the same size.

10						
8						
6						
4						
2						
	1-5	6-10	11-15	16-20	21-25	26-30

Frequency
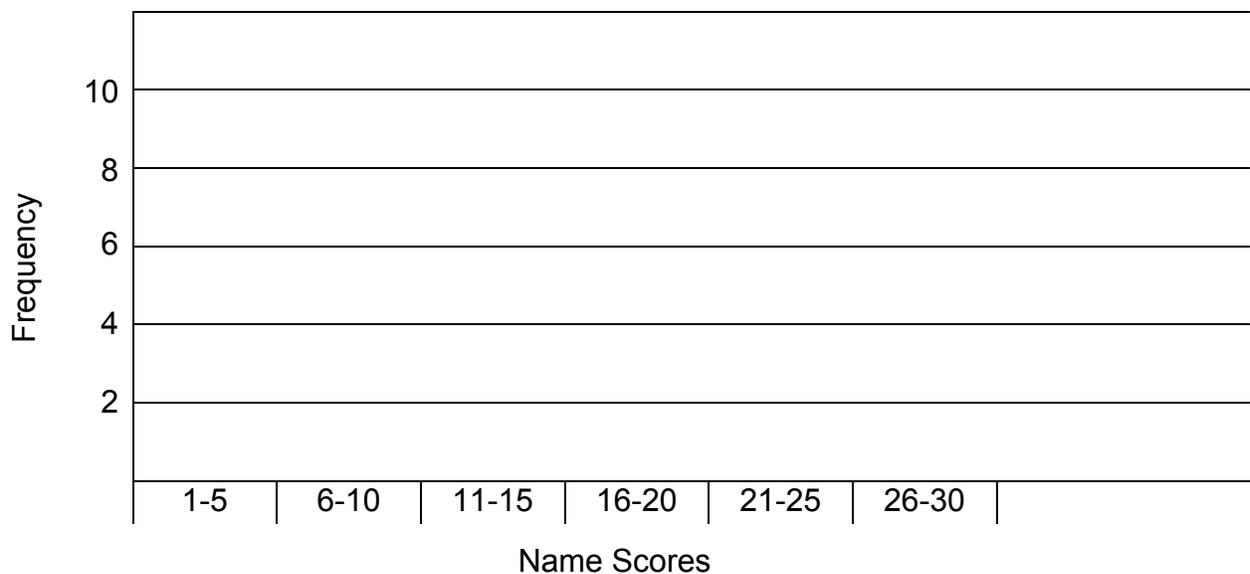
Name Scores

3. Use the five-number-summary to construct a box plot of the class name score data.

$$(\underline{\quad\quad} , \underline{\quad\quad} , \underline{\quad\quad} , \underline{\quad\quad} , \underline{\quad\quad})$$
min Q_1 med = Q_2 Q_3 max

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         5          10          15          20          25          30
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ESTIMATING FISH POPULATIONS

You will do an experiment that simulates a method scientists use to estimate a fish population in a lake. Follow the directions given by your teacher to complete the fish population experiment. Use this sheet to record and analyze data.

S_{tagged} = number of <u>tagged</u> fish in **S**ample P_{tagged} = number of <u>tagged</u> fish in **P**opulation

S_{total} = <u>total</u> number of fish in **S**ample P_{total} = <u>total</u> number of fish in **P**opulation

1. How many fish did you capture and tag from the lake? _____

    What variable described above does this represent? _____

2. "Recapture" samples of fish from the lake. Record your data for S_{tagged} and S_{total}.

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
S_{tagged}						
S_{total}						

3. Use the variables above. Write a proportion for estimating the total number of fish in the lake. This is a mathematical model.

4. Use your model to estimate the number of fish in the lake.

Sample 1	Sample 2	Sample 3
Sample 4	**Sample 5**	**Sample 6**

ESTIMATING FISH POPULATIONS (Continued)

5. What assumptions do you think scientists make when estimating fish populations in this way?

6. Based on your experiment, <u>estimate</u> the number of fish in the population. _____

7. Explain how you arrived at this estimate.

8. Count all the fish. Find the <u>actual</u> number of fish in the population. _____

9. Did you overestimate or underestimate? _____ Was your estimation close? _____

10. Find your error as a percent. Recall the computation: $\left| \dfrac{\text{estimate} - \text{actual}}{\text{actual}} \right|$

11. What might you do to improve your estimate of the number of fish in the lake?

12. In real life, what could weaken the results of collecting a representative sample using this capture-recapture method?

STANDARDS FOR MATHEMATICAL CONTENT	
6.SP.2	Understand that a set of data collected to answer a statistical question has a distribution that can be described by its center, spread, and overall shape.
6.SP.3	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
6.SP.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
6.SP.5a	Summarize numerical data sets in relation to their context, such as by reporting the number of observations.
6.SP.5c	Summarize numerical data sets in relation to their context, such as by giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
7.RP.3	Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*
7.EE.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
7.SP.1	Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
7.SP.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*

STANDARDS FOR MATHEMATICAL PRACTICE
MP2 Reason abstractly and quantitatively.
• Name Scores: Students analyze sets of data using one-variable statistic techniques and graphical displays, and they make sense of the results in the context of the problem.
• Fish Population: Students collect samples of data and use the meaning of proportions in the context of the problem.
MP3 Construct viable arguments and critique the reasoning of others.
• Name Scores: Students explain which measures of center and variability they think are most appropriate.
• Fish Population: Students make inferences based on samples of data and explain their inferences orally and in writing.
MP4 Model with mathematics.
• Name Scores: Students use statistical measures of center and spread to describe real-world applications. Students analyze graphical models of statistical displays to answer questions that encourage the contextualizing of numerical information.
• Fish Population: Students create a mathematical model using proportional reasoning to estimate the population of fish in a lake