Colorado Teacher-Authored Instructional Unit Sample

Mathematics
7th Grade

Unit Title: Data Daze

Extended Evidence Outcomes

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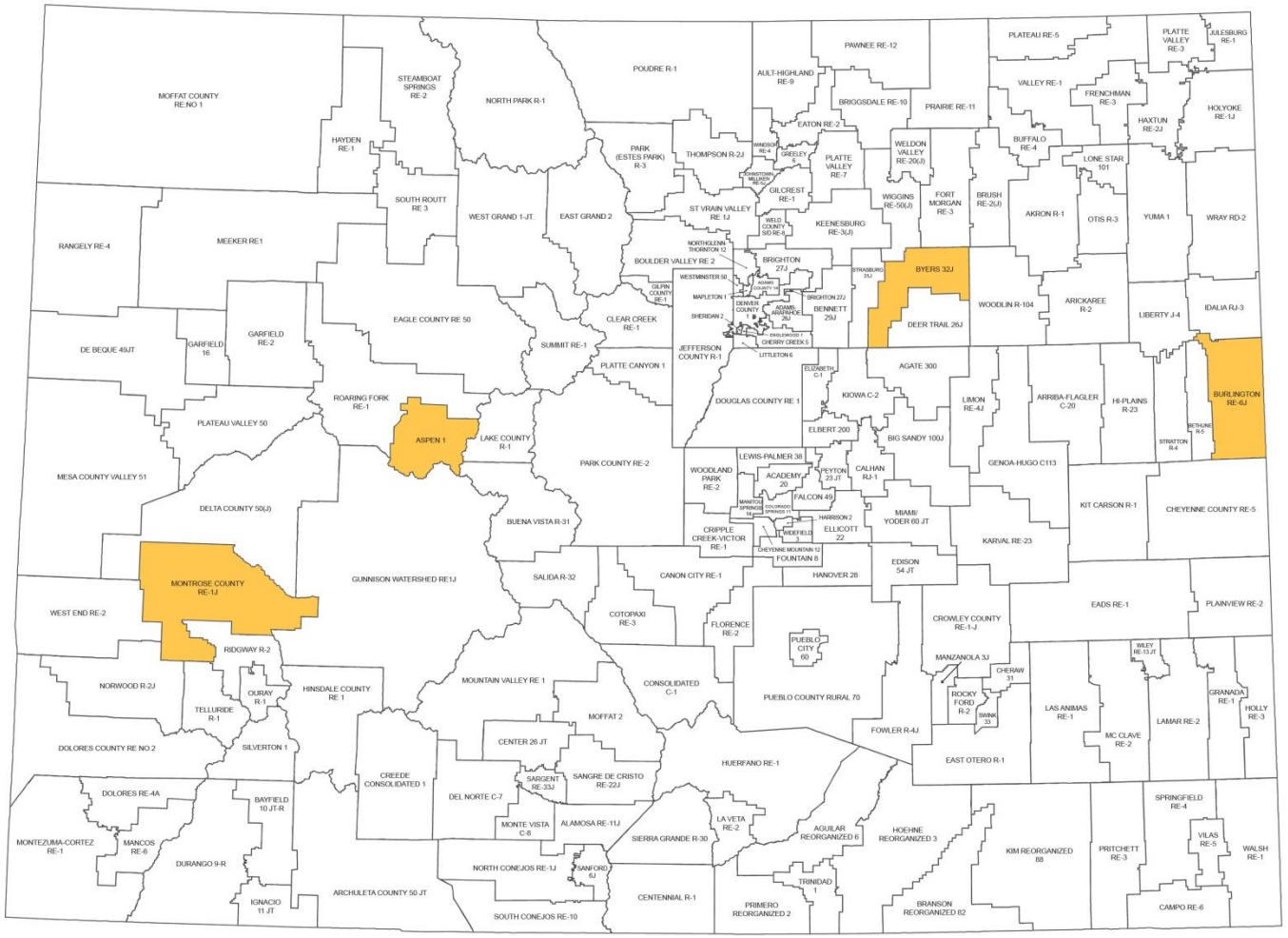

This unit was authored by a team of Colorado educators. The template provided one example of unit design that enabled teacher-authors to organize possible learning experiences, resources, differentiation, and assessments. The unit is intended to support teachers, schools, and districts as they make their own local decisions around the best instructional plans and practices for all students.

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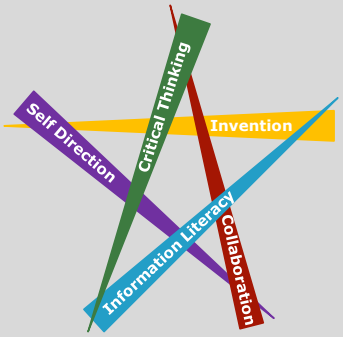
Colorado Teacher-Authored Sample Instructional Unit

Content Area	Mathematics-Extended Evidence Outcomes	Grade Level	7th Grade
Course Name/Course Code			

Standard	Grade Level Expectations (GLE)	GLE Code
1. Number Sense, Properties, and Operations	1. Proportional reasoning involves comparisons and multiplicative relationships among ratios	MA10-GR.7-S.1-GLE.1
	2. Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently	MA10-GR.7-S.1-GLE.2
2. Patterns, Functions, and Algebraic Structures	1. Properties of arithmetic can be used to generate equivalent expressions	MA10-GR.7-S.2-GLE.1
	2. Equations and expressions model quantitative relationships and phenomena	MA10-GR.7-S.2-GLE.2
3. Data Analysis, Statistics, and Probability	1. Statistics can be used to gain information about populations by examining samples	MA10-GR.7-S.3-GLE.1
	2. Mathematical models are used to determine probability	MA10-GR.7-S.3-GLE.2
4. Shape, Dimension, and Geometric Relationships	1. Modeling geometric figures and relationships leads to informal spatial reasoning and proof	MA10-GR.7-S.4-GLE.1
	2. Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure	MA10-GR.7-S.4-GLE.2

Colorado 21st Century Skills



Critical Thinking and Reasoning: *Thinking Deeply, Thinking Differently*

Information Literacy: *Untangling the Web*

Collaboration: *Working Together, Learning Together*

Self-Direction: *Own Your Learning*

Invention: *Creating Solutions*

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Unit Titles	Length of Unit/Contact Hours	Unit Number/Sequence
Data Daze	3 weeks	6

Colorado Teacher-Authored Sample Instructional Unit

This Seventh Grade Mathematics unit Data Daze was developed with adaptations for students who have Significant Support Needs. A way to ensure that these students receive high quality instruction when they are in learning environments with same aged typical peers is by using the Extended Evidence Outcomes and Extended Evidence Competencies that were developed to address their learning needs through standards used by typical students their age. The original source for the Extended Evidence Outcomes and Extended Evidence Competencies was the Mathematics with EEOs document that can be accessed via a link on this page: http://www.cde.state.co.us/cdesped/InstructionalStandards. The adaptations suggested in this unit will not automatically meet the needs of every student but differing needs can usually be addressed by collaboration between special and general educators.

Some parameters that were adhered to when developing these adaptations were an attempt to emphasize principals of universal design and to focus on materials and activities that were free or very inexpensive and would be available to all teachers across the state. There was also an attempt to avoid making the unit overly complex and to keep it a reasonable length. For that reason some Assistive Technology items commonly used by SSN students were not mentioned due to possible problems with cost and availability in various settings,

Adaptations to this unit were created that focus specifically on the Extended Evidence Outcomes. The Extended Evidence Outcomes generally tend to focus more on academic skills and the suggestions for materials and activities made in this unit were made to match or parallel the lessons and activities for typical seventh graders. By contrast the Extended Evidence Competencies tend to focus on SSN students whose needs were more in the area of gaining skills in connecting meaning to symbols, the use of symbolic language in communication, participating in mathematical activities and exploring mathematical materials.

The adaptations suggested in this unit do not specifically address the Extended Evidence Competencies (Content Based Access Skills) that are also listed in the Academic Standards with EEO's document. When working with students whose needs fit best with the Extended Evidence Competencies (Content Based Access Skills) collaboration is particularly essential. Some students may need specialized materials and equipment that may vary substantially from one student to another. Listing the substantial number of possibilities was beyond the scope of this adapted unit and could best be addressed with collaboration with members of the student's special ed. team.

Colorado Teacher-Authored Sample Instructional Unit

Unit Title	Data Daze	**Length of Unit**	3 weeks
Focusing Lens(es)	Random Inference SSN: Drawing conclusions based on available information.	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.7-S.3-GLE.1
Inquiry Questions (Engaging-Debatable):	• How can you declare a winner in an election before counting all the ballots? (MA10-GR.7-S.3-GLE.1-IQ.3) • When playing music, does the shuffle function play songs randomly? • How might the sample for a survey affect the results of the survey? (MA10-GR.7-S.3-GLE.1-IQ.1) • SSN: How can you determine a whole group's preference based on a sample? (MA10-GR.7-S.3-GLE1.EEO.II)		
Unit Strands	Statistics and Probability		
Concepts	Representative, samples, statistics, generalizations, random, population, parameters, inferences, mean absolute deviations, multiplicative, ratio, additive, comparison, unit size, deviations, visual displays, measures of center, measures of variability, numerical data distributions, random sampling, representative samples, estimates, predictions SSN: Group, sample, random, compare, center, middle		

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Representative samples create statistics from which mathematicians make valid generalizations about a population. (MA10-GR.7-S.3-GLE.1-EO.a.i) SSN: Information from a sample of a large group can provide information about the group if the sample represents every kind of member of the group.	What is a statistic? What is a sample? What is a population? What are examples of samples that would not be a valid representation of a population? SSN: Why do we try to learn from samples instead of looking at every member of a large group?	Why do statistics based on a representative sample support generalizations about a population? Why do we investigate samples rather entire populations? SSN: Why would sampling only a part of a large group lead to an incorrect conclusion?
Random and relatively large samples generate sample statistics that estimate population parameters and support valid inferences. (MA10-GR.7-S.3-GLE.1-EO.a.ii, a.iii, a.iv) SSN: Generalizations can be made based on data obtained from a sampling.	How can you choose a representative sample of a population? How do you distinguish between random and bias samples? (MA10-GR.7-S.3-GLE.1-IQ.2) How do statistics from multiple samples generated from the same population compare to each other? SSN: What does random mean when you make a sample of a group?	Why is a random sample a method of generating a representative sample? Why do random samples better estimate or predict information about a population than non-random samples? SSN: What could happen if we make a conclusion about a whole group on a sample of only one part of the group, such as asking a question of only boys when the group has girls and boys in it?

Comparing mean absolute deviations requires a multiplicative (ratio) rather than additive comparison because mathematicians compare the unit size of the deviations to each other. (MA10-GR.7-S.3-GLE.1-EO.b.i) SSN: Data from a graph can be divided into groups based on how far away it is from the mean or average.	What is mean absolute deviation? How do you compare the mean absolute deviations of two data sets? SSN: How can you describe data on a graph by comparing it to the mean?	Why are comparisons of mean absolute deviations stated as a ratio? SSN: Why might it help to know how far a data point is from the mean?
Visual displays, measures of center, and measures of variability for two numerical data distributions from random samples facilitate informal comparative inferences about two populations. (MA10-GR.7-S.3-GLE.1-EO.b.i, b.ii) SSN: Making a visual like a graph can help us to compare groups and see how groups are different and similar.	What are measures of center? What are measures of variability? Which visual displays help mathematicians informally assess the degree of overlap between two numerical data distributions? SSN: How can you find the middle of a set of numbers? Which numbers in this group of numbers are the same? Which ones are different?	How do you determine what measure best represents the data? Why are both measures of center and variability important when comparing two numerical data distributions? SSN: Why is it important to look at how there are differences between parts of groups?
SSN: Mathematicians determine a group's preference based on a sample of the group by identifying the group, which has the most. (MA10 -GR.7-S.3-GLE1-EEO.II)	SSN: What are the choices of the group? Which choice was the most? Greatest? Which choice was the least? Smallest?	SSN: Why does the preference of a group influence individual choices?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- Understand 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 (7.SP.1)
- Understand random sampling tends to produce representative samples and support valid inferences (7.SP.1)
- Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. (7.SP.2)
- Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. (7.SP.2)
- Assess the degree of visual overlap Informally of two numerical data distributions with similar variables, measuring the difference between the centers by expressing it as a multiple of a measure of variability. (7.SP.3)
- Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. (7.SP.4)

SSN:

- Identify whether the information from a small, obviously biased sample can be generalized to the entire population. (MA10-GR.7-S.3-GLE1-EEO.I)
- Draw a conclusion from a graphical representation of survey results (e.g. most students prefer chocolate ice cream, the cafeteria buys more chocolate ice cream than other flavors). (MA10-GR.7-S.3-GLE1-EEO.II)
- Identify the whole number median of a set of single digit numbers using tools and manipulatives. (MA10-GR.7-S.3-GLE1-EEO.III)
- Answer a question related to the collected data from an experiment, given a model of data, or from data collected by the student. (DLM EE.7.SP.1-2)

Critical Language: includes the Academic and Technical vocabulary, semantics, and discourse which are particular to and necessary for accessing a given discipline. EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."*	
A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*When comparing two numerical data distributions, I begin by making a visual comparison using a box plot and then compare the means and mean absolute deviations.* *A random sample of the senior class will better predict the most popular location for prom than only surveying the calculus classes.*
Academic Vocabulary:	Generate, informally, representative, generalizations, inferences, comparison, estimate, predict SSN: more, greater, bigger, most, less, fewer, smaller, least, preference, compare, random, choice, sample, influence, group, estimate, middle, center, median, population
Technical Vocabulary:	Stem and leaf plot, box plot, dot plot, sample, statistics, random, population, mean absolute deviations, multiplicative, ratio, additive, unit size, measures of center, mean, median, measures of variability, inter-quartile range, numerical data distributions, random sampling, representative samples, multiple samples, simulated samples

Colorado Teacher-Authored Sample Instructional Unit

Unit Description:	Data Daze takes students on a journey into random sampling. Students learn to make inferences about a population based on sample data. Students are also introduced to the idea of variation through the mean absolute deviation. This is the first unit in which students explore the connections between samples and populations. These ideas will be extended at the high school level and linked to the concept of standard deviation.
Considerations:	SSN: Students will need access to adapted texts listed below and the presentations or writing that they create will reflect Extended Evidence Outcomes p. 4. All EEO's are preceded by the phrase "With appropriate supports students can". They may also need an alternate ways to communicate understanding or write. Consult SWAAAC team member, SPED teacher or related services professional for assistance with augmentative alternative communication (AAC) device and have an alternate pencil if needed. A worthwhile source of ideas for adapted equipment and software is: http://www.swaaac.com/Catalog/default.asp. Another very useful source of adaptation ideas is : HTTP://WWW.CDE.STATE.CO.US/COEXTENDEDEO (COLORADO INSTRUCTIONAL ACCOMMODATIONS MANUAL)
Unit Generalizations	
Key Generalization:	Visual displays, measures of center, and measures of variability for two numerical data distributions from random samples facilitate informal comparative inferences about two populations SSN: Making a visual like a graph can help us to compare groups and see how groups are different and similar
Supporting Generalizations:	Representative samples create statistics from which mathematicians make valid generalizations about a population SSN: Information from a sample of a large group can provide information about the group if the sample represents every kind of member of the group.
	Random and relatively large samples generate sample statistics that estimate population parameters and support valid inferences SSN: Generalizations can be made based on data obtained from a sampling.
	Comparing mean absolute deviations requires a multiplicative (ratio) rather than additive comparison because mathematicians compare the unit size of the deviations to each other SSN: Data from a graph can be divided into groups based on how far away it is from the mean or average.
	SSN: Mathematicians determine a group's preference based on a sample of the group by identifying the group, which has the most (MA10 -GR.7-S.3-GLE1-EEO.II)

Performance Assessment: *The capstone/summative assessment for this unit.*	
Claims: (Key generalization(s) to be mastered and demonstrated through the capstone assessment.)	Visual displays, measures of center, and measures of variability for two numerical data distributions from random samples facilitate informal comparative inferences about two populations. SSN: Making a visual like a graph can help us to compare groups and see how groups are different and similar.
Stimulus Material: (Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization)	You are a product researcher and a cell phone company has hired you to study the cell phone habits of middle school students in your community (e.g., calls, texts, Tweets, Instagram, Vine). The company wants to study how boys use their cell phones in comparison to girls. You will need to create an unbiased sampling method to determine if the two populations have different device needs. Based on your findings you will help the company decide if it is a good business decision to design different cell phone plans for the two populations. For example, does one population text more than the other, or use the phone features and apps more often, or in different ways? SSN: You can conduct a survey on individual preferences in the cafeteria (e.g, favorite type of ice cream).

Product/Evidence: (Expected product from students)	Students will create a report for the cell phone company based on a survey question they designed related to cell phone usage. The survey data must be numerical (e.g., frequency of tweets, number of apps used). The presentation should include: • strategy used to create a representative sample of middle school students in the community • visual displays of the sample data for girls versus boys • means, ranges, and mean absolute deviations for each sample Students should also make recommendations to the cell phone company about marketing and designing cell phone plans based on inferences resulting from their sampling data. SSN: Students can create a visual representation of the data collected by creating a graph.
Differentiation: (Multiple modes for student expression)	Students can present their findings through video, Prezi, animation, or PowerPoint. Students can work in groups to create their survey question and collect data. Computer graphing programs can be used to create the visual displays for students: http://nces.ed.gov/nceskids/createagraph/default.aspx http://illuminations.nctm.org/ActivityDetail.aspx?ID=220 http://illuminations.nctm.org/ActivityDetail.aspx?ID=204 SSN: Student can use assistive tech devices, concrete objects and/or pictures of items to present their findings. http://www.kidsmathgamesonline.com/pictures.html (free math pictures to use for pictographs)

Texts for independent reading or for class read aloud to support the content	
Informational/Non-Fiction	**Fiction**
How Many Ants in an Anthill by Kate Boehm Jerome (Lexile level 710) *If the World Were a Village: A Book about the World's People* by David Smith (Lexile level 840) *This Child, Every Child: A Book about the World's Children* by David Smith (Lexile level 1020) SSN: Books on math from Tarheel reader: http://tarheelreader.org/find/?search=math&category=&reviewed=R&audience=E&language=en&page=1 *Graphing My Favorite Things* by Jennifer Marrews	*Conned Again Watson! Cautionary Tales of Logic, Math, and Probability* by Colin Bruce (Lexile level 950) *Mind Games* by Jeanne Grunwell (Lexile level 760)

Ongoing Discipline-Specific Learning Experiences				
1.	Description:	Think/work like a mathematician – Expressing mathematical reasoning by constructing viable arguments, critiquing the reasoning of others [Mathematical Practice 3]	Teacher Resources:	http://schools.nyc.gov/Academics/CommonCoreLibrary/TasksUnitsStudentWork/default.htm (lesson plans contains exemplars that could be replicated for students to critique the reasoning of others) http://map.mathshell.org/materials/index.php (samples and examples of student work to critique the validity of others) www.exemplars.com/resources/rubrics/assessment-rubrics (standards-based math rubric for the students to assess other's work) SSN: Lesson plan and printable materials for gathering data and creating graphs.

				http://school.discoveryeducation.com/teachersguides/pdf/math/ds/DM_data_graphs.pdf
			Student Resources:	SSN: https://www.ixl.com/math/grade-1/which-bar-graph-is-correct (Online game to choose the graph that is correct.)
	Skills:	Construct and communicate a complete and concise response, justify a conclusion using correct vocabulary, interpret and critique the validity of other's conclusions and reasoning, and identify errors and present correct solutions [Mathematical Practice 4]	Assessment:	Students analyze and defend their solutions for each major learning experience. Careful attention should be paid to precise use of vocabulary and symbols. Periodically throughout the unit, students can also be provided with flawed solutions and asked to identify, describe, and correct the flaw. SSN: Student can explain, using the unit vocabulary, which choice is the preferred one based on a visual representation of the data.
2.	Description:	Think/work like a mathematician – Engaging in the practice of modeling the solution to real world problems	Teacher Resources:	https://www.sites.google.com/a/cmpso.org/caccss-resources/k-8-modeling-task-force/k-8-modeling-resources (examples of modeling problems and resources for teachers on teaching and scoring them) http://www.insidemathematics.org/index.php/standard-4 (video examples of students modeling with mathematics) http://learnzillion.com/lessons/1722-solve-multistep-word-problems-using-model-drawing (video about modeling)
			Student Resources:	N/A
	Skills:	Model real world problems mapping relationships with appropriate models, analyze relationships to draw conclusions, interpret results in relation to context, justify and defend the model, and reflect on whether results make sense	Assessment:	Modeling Problems Students can use statistical models to represent and analyze relationships between two real world samples to make inferences about populations in relation to the context of the problem. SSN: Student can select a topic of interest (e.g. ice cream flavor), plan and conduct a survey, record results and display them in a pictorial representation (e.g., pictograph, line graph).
3.	Description:	Mathematicians fluently add, subtract, multiply, and divide rational numbers	Teacher Resources:	N/A
			Student Resources:	http://www.mangahigh.com/en_us/games (math games for building fluency with rational numbers) http://coolmath-games.com/ (math games for building fluency with rational numbers) http://hotmath.com/games.html(math games for building fluency with rational numbers) SSN: https://www.ixl.com/math/grade-1 (Index of free games for practicing addition and subtraction)

	Skills:	Add, subtract, multiply and divide rational numbers, the culmination of fluency skills extended to negative numbers	Assessment:	Fluency Problems Students can build fluency through consistent practice with all four operations on rational numbers. SSN: Student completes arithmetic problems at their level with needed supports, manipulatives and materials.

Prior Knowledge and Experiences

Student familiarity with the mean, median, and graphical representations (e.g., bar graph, histogram, box plots) provides a strong foundation for this unit. The first two learning experiences in this unit review these concepts. Teachers should adjust the length of the experiences based on students' prior exposure to these concepts. This is the final unit in seventh grade. A major concept within this grade level is proportional reasoning, which is extended to include statistical concepts in this unit.
SSN: Game reviewing mean median for review: http://www.k5learning.com/sample-lessons/grade-3-data-analysis

Learning Experience # 1		
The teacher may provide a population for which counting would be either impossible or inefficient to determine its size (e.g., a tree population) so that students can try their hand at creating a method for estimating the size of a population.		
Teacher Notes:	This learning experience is intended as a pre-assessment of students' understanding of populations and samples. Teachers may observe students strategies and listen to their conversations to determine their prior knowledge. Estimating a population size will be revisited later in the unit when students have learned more sophisticated strategies.	
Generalization Connection(s):	Representative samples create statistics from which mathematicians make valid generalizations about a population SSN: Information from a sample of a large group can provide information about the group if the sample represents every kind of member of the group.	
Teacher Resources:	http://map.mathshell.org/materials/tasks.php?taskid=386&subpage=expert (lesson about using sampling to estimate a population)	
Student Resources:	N/A	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: Why is counting an inefficient and sometimes impossible strategy when determining the size of a population? How confident are you in your estimate of the size of the population? Beyond counting every object in the population, what other strategies could you try to improve your estimate? What are some examples of populations, which might be hard to count and yet an estimate of their size is important? What would you do differently if asked to estimate again? SSN: Student will understand that some items are too numerous to count. Sometimes, one must estimate a number instead of counting each item. For example, counting the number of M&Ms in a bag or pieces of cereal in a box.	
Differentiation:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)

(Multiple means for students to access content and multiple modes for student to express understanding.)	The teacher may modify the population to make it smaller or less complex SSN: The teacher may provide concrete examples and visual examples. SSN:https://www.nsa.gov/academia/_files/collected_learning/elementary/data_analysis/favorites_fun_with_bar_graphs.pdf (Lesson plan with materials)	Students can estimate the size of a less complex population SSN: Student can use concrete examples and/or visual examples.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	N/A
Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • SSN: Identify whether the information from a small, obviously biased sample can be generalized to the entire population. (MA10-GR.7-S.3-GLE1-EEO.I)	
Critical Language:	Estimate, explain, population, inefficient, efficient SSN: choice, sample, group	

Learning Experience # 2	
The teacher may show data in a variety of graphical representations so that students can discuss the advantages of different types of graphical representations to communicate data.	
Teacher Notes:	This learning experience is also a pre-assessment activity to help teachers determine what prior knowledge and skills students have with analyzing a variety of graphical representations.
Generalization Connection(s):	Representative samples create statistics from which mathematicians make valid generalizations about a population Visual displays, measures of center, and measures of variability for two numerical data distributions from random samples facilitate informal comparative inferences about two populations SSN: Making a visual like a graph can help us to compare groups and see how groups are different and similar SSN: Information from a sample of a large group can provide information about the group if the sample represents every kind of member of the group.
Teacher Resources:	http://www.mdk12.org/instruction/curriculum/mathematics/standard4/grade7.html (school Improvement in Maryland provides examples of graphs in their sample assessments) http://www.docstoc.com/docs/61672468/Graphical-Representation-of-Data-GRAPHICAL (discussion on the advantages of different types of graphical representations) SSN: https://www.youtube.com/watch?v=W9BhzvLooI4 (short power point You tube review of types of graphs)

	SSN: https://www.pinterest.com/search/pins/?q=graphing (numerous resources for teaching graphs)	
Student Resources:	SSN: https://www.youtube.com/watch?v=gX9mAL8ixzI (learn about bar graphs video) SSN: https://www.youtube.com/watch?v=iwZJvh_7oqA (learn about tally marks video) SSN: https://www.youtube.com/watch?v=hKHgqqk4NbE (learn about data handling video) SSN: http://www.mathsisfun.com/data/survey-conducting.html (different kinds of graphs illustrated)	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: How can line plots, bar graphs and box and whisker plots help you to describe data? What are the similarities and differences between line plots, bar graphs and box and whisker plots? SSN: Student will be able to show data in two different styles (e.g., manipulatives, tallies, pictograph). SSN: Student will use critical vocabulary (e.g., more, less) to explain the data.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://au.ixl.com/math/year-6 (extra practice analyzing graphs in the section data and graphs) SSN: The teacher may provide concrete examples and visual examples.	Students can answer questions about graphs to support fluency with each of the graphical models SSN: Students can identify different types of graphs when provided concrete and visual examples.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://www.docstoc.com/docs/61672468/Graphical-Representation-of-Data-GRAPHICAL (discussion on the advantages of different types of graphical representations) http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (thinking map for comparing and contrasting)	Students can complete a graphic organizer comparing two different types of graphs
Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • Draw a conclusion from a graphical representation of survey results (e.g. most students prefer chocolate ice cream, the cafeteria buys more chocolate ice cream than other flavors). (MA10-GR.7-S.3-GLE1-EEO.II)	
Critical Language:	Line plots, bar graphs, box and whisker plots, analyze SSN: more, greater, bigger, most, less, fewer, smaller, least	

Learning Experience # 3
The teacher may provide students with the opportunity to measure items in order to create a data set (e.g., foot size, hand

span) so that students can explore the meaning of the mean, median and range.

Enactive: Students can use cubes to determine the median by lining up the set of data from least to greatest. Students can use cubes to find the mean by leveling off the set of data. Students can use cubes to find the range of a set of data by seeing the difference between the largest and smallest data point.
Iconic: Students can create a line plot and determine the mean, median and range on the line plot.
Symbolic: Students can find the mean, median and range of a given set of data in a table.

Generalization Connection(s):	Representative samples create statistics from which mathematicians make valid generalizations about a population SSN: Information from a sample of a large group can provide information about the group if the sample represents every kind of member of the group.	
Teacher Resources:	www.teachersnotebook.com/product/mhanson01/smartboard-interactive-mean-median-mode-and-range-practice (practice with mean, median and range) SSN: complete activity that uses the 5 die. www.bbc.co.uk/bitesize/ks2/maths/data/mode_median_mean_range/play (video about the mean, median, and range) SSN: http://www.biologycorner.com/worksheets/estimating_population_size.html (lesson plan on sampling large populations)	
Student Resources:	SSN: http://www.kidsmathgamesonline.com/numbers/meanmedianmode.html (free online games teaching mean, median mode)	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: How can you find the mean, median and range of a given data set? When might a median be better for calculating your math grade? Why are the median and the mean both called measures of center? SSN: What number or item is in the middle when they are put in sequential order? (Given an example).	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with smaller sets of data SSN: The teacher may provide a visual of a median, which is found in the middle of the road.	Students can determine the mean, median, and range using manipulatives for smaller sets of data SSN: Student can manipulate concrete items to find the median.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://www.youtube.com/watch?v=-LtFWjtTBSw (video creating a graphic novel using an online template)	Students can create a short graphic novel titled the outliers that illustrates how outliers affect the mean and the median
Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • SSN: Answer a question related to the collected data from an experiment, given a model of data, or from data collected by the student. (DLM EE.7.SP.1-2)	
Critical Language:	Mean, median, range, algorithm, calculate, data set, and line plot SSN: middle, median	

Learning Experience # 4

The teacher may describe a population and give examples of different types of sampling methods so that students can identify

what makes a sample either biased or unbiased. *Enactive*: Students can explain and discuss their understanding of bias in samples as they look at the examples of the sampling methods. *Iconic*: Students can label the different types of sampling to demonstrate their understanding of which factors contribute to sample bias. *Symbolic*: Students can choose a population, create a sampling method, and justify what makes their sampling method representative of the population.		
Teacher Notes:	Students tend to struggle with the concept of bias or fairness in a sample, often confusing this concept with their own concept of fair. For example, the students may declare a sample to be biased if they are not included in the sample or if the results disagree with their opinions.	
Generalization Connection(s):	Random and relatively large samples generate sample statistics that estimate population parameters and support valid inferences SSN: Generalizations can be made based on data obtained from a sampling	
Teacher Resources:	http://www.rsm.rcs.k12.tn.us/teachers/Robertsont/6.5.3%20Biased%20Samples%20Lesson,%20Practice,%20and%20Quiz.pdf (lesson on what makes a sample biased) http://eric.ed.gov/?id=EJ600186 "How Do Students Think About Statistical Sampling Before Instruction?" by Victoria Jacobs http://www.utexas.edu/academic/ctl/assessment/iar/teaching/gather/method/survey-Sampling.php?task=research (describes various types of sampling) SSN: http://www.nsta.org/publications/news/story.aspx?id=49386 (lesson plan on sampling)	
Student Resources:	http://learnzillion.com/lessons/1844-identify-a-random-sample (video lesson on identifying a random sample) SSN: http://www.pbslearningmedia.org/resource/mgbh.math.sp.fishsample/random-sampling-how-many-fish/ (short video on selecting a random sample) SSN: http://www.mathsisfun.com/data/survey-conducting.html (sampling section)	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: What makes a sample unbiased? What should you look for to determine whether a sample is biased? Why might it be useful to have more than one sample? What are some examples of samples that would not be a valid representation of a population? How do you distinguish between a random and biased sample? How can you choose a representative sample of a population? Why do random samples better estimate or predict information about a population than non-random samples? SSN: What kind of group (sample) should you ask? Who should you ask? How many people should you ask?	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a completed model comparing biased and unbiased samples The teacher may provide explanations of sampling methods that are biased and unbiased SSN: The teacher may provide visuals of different types of people (children, teens, adults, elderly, friends, strangers) to choose the best group to answer the question.	Students can recognize the differences between a biased and an unbiased sample by separating examples of samples into groups based on the types of sampling methods provided by the teacher SSN: Student can use visuals of different types of people (children, teens, adults, elderly, friends, strangers) to choose the best group to answer the question.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)

	http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+census+and+sample (pros and cons of census versus sample) http://www.scienceclarified.com/dispute/Vol-2/Should-statistical-sampling-be-used-in-the-United-States-Census.html#b (article on pros and cons of census versus sample)	Students can create a summary of the pros and cons of conducting a census as opposed to taking a random sample of a population
Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • 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 • SSN: Answer a question related to the collected data from an experiment, given a model of data, or from data collected by the student. (DLM EE.7.SP.1-2)	
Critical Language:	Biased, unbiased, sample, population, representative, accurate, random SSN: Sample, group	

Learning Experience # 5	
The teacher may model several sampling methods for determining a population size so that students can explore the efficiency of sampling methods in comparison to counting an entire population. *Enactive*: Students can determine the size of populations (e.g. bag of marbles, jellybeans) by using sampling methods. *Iconic*: Students can create ratio tables to examine the proportionality between samples and populations. *Symbolic*: Students can create a visual representation of the data collected from numerous samples, and create inferences based on the visual representations of the samples.	
Teacher Notes:	Students often struggle with inferences made about a population based on a sample. The teacher may want to lead a discussion about the concept of statistical measures as estimates of information that would be very difficult to obtain exactly.
Generalization Connection(s):	Random and relatively large samples generate sample statistics that estimate population parameters and support valid inferences SSN: Generalizations can be made based on data obtained from a sampling
Teacher Resources:	http://eric.ed.gov/?id=EJ580572 "Capture and Recapture: Your Students' Interest in Statistics" by June Morita http://cms.cerritos.edu/uploads/MathGateways/Ratios/Mario%20Title%20V%20Experiment%20-%20combined%20file.pdf (teaching notes for the Capture and Recapture lesson) http://learnzillion.com/lessons/1848-make-inferences-about-a-population-by-analyzing-random-samples (video on making inferences by analyzing random samples) http://www.illustrativemathematics.org/illustrations/974 (examples task about sampling) http://www.pbslearningmedia.org/resource/midlit11.math.splsamp/population-sampling-fish/ (video about population sampling) SSN: http://www.mathsisfun.com/data/survey-conducting.html (lesson plan on drawing inferences)
Student Resources:	http://www.hoodamath.com/tutorials/7thgrade/Using_Measures_of_Center_to_Draw_Inferences_About_Two_Populations_Example_1.html (video example of drawing inferences about populations)

Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: When does a sample sufficiently represent the population? How can a random sample of a larger population be used to draw inferences? How do statistics (e.g., mean, median, range) from multiple samples generated from the same population compare to each other? SSN: How can you improve your guess on the number of jellybeans in a jar?	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with a method for sampling and pair students at similar levels of understanding SSN: The teacher may provide visuals of different sample sizes	Students can determine the size of a population using a sampling method provided by the teacher SSN: Students can use visuals of different sample sizes to show what is best.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://wildlife.state.co.us/Pages/Home.aspx (Colorado Division of Wildlife)	Students can write a report about sampling methods used to determine the size of a population of animals used by the Department of Natural Resources
Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • 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 • SSN: Answer a question related to the collected data from an experiment, given a model of data, or from data collected by the student. (DLM EE.7.SP.1-2)	
Critical Language:	Variability, distribution, inference, sample, population SSN: sample, group	

Learning Experience # 6	
The teacher may revisit the first learning experience so that students can critique the strengths and weaknesses of their initial methods for sampling and find a more accurate and efficient method. (e.g., a tree population).	
Teacher Notes:	This learning experience revisits the first learning experience but students can now use more sophisticated methods by applying their understanding of line plots, samples, means, medians, and ranges.
Generalization Connection(s):	Random and relatively large samples generate sample statistics that estimate population parameters and support valid inferences SSN: Generalizations can be made based on data obtained from a sampling
Teacher Resources:	http://map.mathshell.org/materials/tasks.php?taskid=386&subpage=expert (counting trees formative assessment lesson)
Student Resources:	http://www.bbc.co.uk/bitesize/ks2/maths/data/mode_median_mean_range/play/ (game to practice mean, median, and range) SSN:

	Video game reviewing mean median range etc : http://www.k5learning.com/sample-lessons/grade-3-data-analysis Video game to teach mean, median, mode: http://www.kidsmathgamesonline.com/numbers/meanmedianmode.html	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: Why would you use a mean or median to estimate the population of the trees? What size sample is sufficient to estimate the population? Do the estimates from your sample accurately represent the population? Why or why not? What is a sample? What is a population? Why do statistics based on a representative sample support generalizations about a population? Why do we investigate samples rather than entire populations? SSN: What is a sample? What is a population? What is the difference between sample and population?	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with possible solution strategies for sampling http://map.mathshell.org/materials/tasks.php?taskid=386&subpage=expert (counting trees formative assessment lesson with possible solution strategies) SSN: The teacher may provide visuals of both samples and populations.	Students can analyze possible solution strategies in order to create a more accurate and efficient strategy SSN: Student will identify a sample and a population from two visual representations.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	N/A
Key Knowledge and Skills:	• Assess the degree of visual overlap Informally of two numerical data distributions with similar variables, measuring the difference between the centers by expressing it as a multiple of a measure of variability • SSN: Identify whether the information from a small, obviously biased sample can be generalized to the entire population. (MA10-GR.7-S.3-GLE1-EEO.I)	
Critical Language:	Estimate, diagram, method, accurate, explain SSN: Sample, population	

Learning Experience # 7	
The teacher may give students a mean for a context (e.g., number of people per home) so that students can create several possible data distributions for the given mean to explore the concept of variation (e.g., Mean Absolute Deviation). *Enactive*: Students can create a variety of line plots with sticky notes for the given mean. *Iconic*: Students can rank the line plots from those with the most to the least variation and describe their reasoning for the ranking. *Symbolic*: Students can use MAD (Mean Absolute Deviation) to determine the variation from the mean. Students can then interpret the meaning of the MAD in a provided context.	
Generalization Connection(s):	Comparing mean absolute deviations requires a multiplicative (ratio) rather than additive comparison because mathematicians

	compare the unit size of the deviations to each other Visual displays, measures of center, and measures of variability for two numerical data distributions from random samples facilitate informal comparative inferences about two populations SSN: Data from a graph can be divided into groups based on how far away it is from the mean or average. SSN: Making a visual like a graph can help us to compare groups and see how groups are different and similar	
Teacher Resources:	http://www.learner.org/courses/learningmath/data/pdfs/session5/mads_1.pdf (article by Gary Kader describing this learning experience in more detail) http://www.illustrativemathematics.org/7.SP.B (tasks related to this concept, offensive Linemen or college athletes) http://learnzillion.com/lessons/1462-make-comparative-inferences-using-the-mad (video about the MAD)	
Student Resources:	www.ixl.com/math/algebra-1/mean-absolute-deviation (practice calculating the MAD) http://tulyn.com/absolute_value.htm (review of absolute value)	
Assessment:	Students mastering the concept and skills of this lesson should be able to answer questions such as: What is the mean absolute deviation? How is variability of data sets measured? Why do we measure the variability of a data set? What would happen if we didn't use the absolute value when calculating the MAD? What can you tell about a data that has a small versus a large MAD? SSN: What is the mean of a set of data by leveling different towers of unifix cubes for two sets of data?	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CC8QFjAB&url=http%3A%2F%2Fmahaffeymath.wikispaces.com%2Ffile%2Fview%2FMean%2BAbsolute%2BDeviation%2Bgraphic%2Borganizer.docx&ei=_bRyUo_wEc_eyQHw9YHwBg&usg=AFQjCNGihLNDIvCk3AYssA4i6iGhVZGAVg&bvm=bv.55819444,d.aWc (graphic organizer for MAD) SSN: The teacher can provide a visual of a mean, which is found leveling unifix cubes of different heights	Students can calculate the MAD using a graphic organizer SSN: Student can identify the mean using a concrete representation of the data such as unifix cubes
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	http://sahilmohnani.wordpress.com/2013/06/02/absolute-mean-deviation/ (discussion on the MAD versus standard deviation) http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (thinking map for comparing and contrasting)	Students can create a reflection addressing the similarities and differences between standard deviation and mean absolute deviation

Key Knowledge and Skills:	• Understand 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 random sampling tends to produce representative samples and support valid inferences • 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 • Assess the degree of visual overlap Informally of two numerical data distributions with similar variables, measuring the difference between the centers by expressing it as a multiple of a measure of variability • Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations • SSN: Answer a question related to the collected data from an experiment, given a model of data, or from data collected by the student. (DLM EE.7.SP.1-2)
Critical Language:	Absolute value, deviation, variance, distribution, mean absolute deviation (MAD) SSN: Mean, middle, leveling