Data Analysis, Statistics & Probability

CONTENT STANDARD #11	
Pose questions and collect, organize, and represent data to answer those questions	**Topic: Fluency with Data**

Understanding(s): *Students will understand that…*

- Data helps people to understand situations and make informed decisions.
- Understanding data can lead to educated predictions and conclusions.
- Describing things as accurately as possible enables people to more effectively communicate their observations.
- Graphical displays of numbers make it possible to spot patterns that are not otherwise obvious.
- Sometimes, certain representations can be fashioned to be misleading.
- Data can be represented in many ways (i.e., tables, charts, graphs).

Essential Question(s):

- How does one design an investigation that requires the collection and study of data?
- How does one represent, analyze, and communicate data to make informed decisions?

Knowledge: *Students will know…*

- Sorting according to given attributes.
- Sample size, method of sampling affects results.
- The difference between numeric data and categorical data.

Skill(s): *Students will be able to…*

- Sort objects or people.
- Collect and organize information into tables or graphs.
- Create bar graphs, line plots, line graphs, pictographs, circle graphs, histograms, stem and leaf plots, box and whisker plots, and scatter plots.
- Design a study (sampling techniques).
- Label parts of a graph.
- Compare two samples of data.

Grade	Reference	Benchmark
Grade 8	MA.8.11.1	Design a study that compares two samples, collect data, and select the appropriate representation (e.g., double bar graph, back-to-back stem and leaf plot, parallel box and whisker plots, scatter plot) to compare the sets of data
	MA.8.11.2	Judge the validity of data based on the data collection method
Grade 7	MA.7.11.1	Design a study, collect data, and select the appropriate representation (line graph, bar graph, circle graph, histogram, stem and leaf plot, box and whisker plot) to display the data
Grade 6	MA.6.11.1	Analyze how data collection methods and sample size can affect the results of data sets
Grade 5	MA.5.11.1	Collect and display data in circle graphs
	MA.5.11.2	Recognize the difference in representing numeric data and categorical data and select appropriate representations to display each type of data
Grade 4	MA.4.11.1	Pose questions, collect data using observations and experiments, and organize the data into tables or graphs
	MA.4.11.2	Label the parts of a graph (e.g., axes, scale, legend, title)
Grade 3	MA.3.11.1	Pose questions, collect data using surveys, and organize the data into tables and graphs
	MA.3.11.2	Organize and represent data in more than one way (e.g., tallies, chart, tables, bar graphs, line plots, line graphs)
Grade 2	MA.2.11.1	Pose questions, collect data, and display the data using a graph (e.g., bar graphs, pictographs)
Grade 1	MA.1.11.1	Collect and organize information using concrete objects and pictures
Grade K	MA.K.11.1	Sort objects or people according to stated attributes

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational ←→ Approaching Proficiency					
Students will	Students will	Students will	Students will		Students will
• Draw conclusions given a graph that compares two sets of data, e.g., double bar graph, back-to-back stem and leaf plot, parallel box and whisker plot, scatter plot.	• Construct double bar graphs, back-to-back stem and leaf plots, parallel box and whisker plots, scatter plots when data is provided.	• Design a study that will allow comparing one sample to another, e.g., a study to compare the favorite lunch of sixth graders vs. eighth graders; a study to compare the heights of eighth grade boys to eighth grade girls. • Collect data from samples of the two populations that are being compared.	• Design a study that will allow comparing one sample to another, e.g., a study to compare the favorite lunch of sixth graders vs. eighth graders; a study to compare the heights of eighth grade boys to eighth grade girls. • Collect data from samples of the two populations that are being compared. • Decide which type of graph will visually compare the data. • Create the graph. • Draw conclusions based on the comparison.	**MA.8.11.1** **Design a study that compares two samples, collect data, and select the appropriate representation (e.g., double bar graph, back-to-back stem and leaf plot, parallel box and whisker plots, *scatter plot – first time introduced*) to compare the sets of data**	
		• Define bias, i.e., favoring some parts of the population over others; systematically favoring certain outcomes of an experiment or simulation.	• Question the method used to collect data. • Relate any bias in the data to the collection method (if plausible).	**MA.8.11.2** **Judge the validity of data based on the data collection method**	

(Gr. 8)

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational ←——→ Approaching Proficiency					
	Students will	**Students will**	**Students will**	**Students will**		**Students will**
Gr. 7	• Draw conclusions given a graph, e.g., line graph, bar graph, circle graph, histogram, stem and leaf plot, box and whisker plot.	• Construct a line graph, bar graph, circle graph, histogram, stem and leaf plot, and/or box and whisker plot when the data is provided.	• Design a study to investigate something of interest. • Collect data. • Describe the different purposes for each graph.	• Design a study (involving an experiment or survey) to investigate something of interest. • Collect data. • Choose how to best display the data so that others can make sense of the data. *NOTE: The student must be able to choose and make the most appropriate representation for the data.*	**MA.7.11.1** **Design a study, collect data, and select the appropriate representation (line graph, bar graph, circle graph, histogram, stem and leaf plot, box and whisker plot – first time introduced) to display the data** *NOTE: This is the first time that box and whisker plots and histograms are introduced. Similar to MA.8.11.1 but with only one sample.*	
Gr. 6				• Compare one method of collecting data to another and describe how each may affect the results, e.g., collecting data from just one gender or surveying what your favorite sport is at a basketball game distorts results. • Compare the results of a survey with a small sample size to the same survey with a larger sample size and describe how the size of the sample may affect the results.	**MA.6.11.1** **Analyze how data collection methods and sample size can affect the results of data sets** *NOTE: Combine with MA.6.13.1*	

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational ← → Approaching Proficiency					
Students will	Students will	Students will	Students will		Students will
Gr. 5	• Identify fractions and percents as the main modes of display for a circle graph.	• Label a circle graph with the correct data, e.g., given an unlabeled circle graph, the student inputs the data in the correct sector.	• Calculate correct percentages or fractions for a circle graph for a given set of data. • Recognize that only data totaling 100% can be displayed on a circle graph.	• Collect data that can be represented in a circle graph. • Display the collected data in a circle graph by applying the calculated percentages/ fractions to 360°.	**MA.5.11.1** **Collect and display data in circle graphs** *NOTE: Students will need to know how to construct angles. See MA.6.4.2.*	
		• Identify whether given data is numerical or categorical.	• Identify whether a given graph is appropriate to display given numeric data or categorical data.	• Describe the difference in representing numeric vs. categorical data, i.e., mean, median, mode, and range can be found in numerical data. Only the mode can be found in categorical data. • Select an appropriate type of graph to display numeric data and categorical data.	**MA.5.11.2** **Recognize the difference in representing numeric data and categorical data and select appropriate representations to display each type of data**	• Give examples and describe the difference in representing numeric data and categorical data. • Justify the most appropriate representation.
Gr. 4			• Collect data for questions provided by the teacher. • Collect data using an experiment provided by the teacher. • Organize collected data into a given table or graph.	• Develop questions that can be answered through an investigation. • Collect data through observations and experiments provided by the teacher. • Organize the collected data into tables or graphs. *NOTE: The student must be able to make the table or graph.*	**MA.4.11.1** **Pose questions, collect data using observations and experiments, and organize the data into tables or graphs**	

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational ← → **Approaching Proficiency**					
Students will	Students will	Students will	Students will		Students will
			• Title the graph. • Label axes, including the units of measure. • Number axes using even intervals. • Provide a legend, if necessary, to define colors or symbols used in the graph.	**MA.4.11.2** **Label the parts of a graph** **(e.g., axes, scale, legend, title)**	
Gr. 3		• Collect data using a survey provided by the teacher. • Organize collected data into a given table or graph.	• Compose questions and collect data using a survey format, e.g., oral or written questionnaire. • Organize the collected data into tables and graphs. *NOTE: The student must construct the table/graph.*	**MA.3.11.1** **Pose questions, collect data using surveys, and organize the data into tables and graphs** *NOTE: This benchmark is very similar to 4.11.1.*	
		• Create a line plot or tally chart using a given data set.	• Organize raw, i.e., unorganized data. • Represent data in more than one way.	**MA.3.11.2** **Organize and represent data in more than one way (e.g., tallies, chart, tables, bar graphs, line plots, line graphs)** *NOTE: This benchmark is very similar to 4.11.1.*	
Gr. 2		• Compose a non-quantifiable question, e.g., what's your name? How do you make a cake? • Collect data in an unorganized way, e.g., lists data randomly. • Represent data using a GIVEN graph.	• Compose a quantifiable question, e.g., what's your favorite color? How many siblings do you have? • Pose questions to collect data in an organized way, e.g., list data by tallying, make a table. • Represent the data on a graph.	**MA.2.11.1** **Pose questions, collect data, and display the data using a graph (e.g., bar graphs, pictographs)**	

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational ← → Approaching Proficiency					
Students will	Students will	Students will	Students will		Students will
Gr. 1			• Collect and organize the information into a pre-made/given chart using concrete objects and pictures provided by the teacher, e.g., tally marks, graphs, charts.	**MA.1.11.1 Collect and organize information using concrete objects and pictures**	• Independently organize information in several ways.
Gr. K		• Match items (one-to-one, same size and shape) that are the same.	• Place objects or people that share similar attributes, e.g., by color, by shape, by size, by use, etc., together into the same groups. *NOTE: Teacher tells students which attribute(s) to use.*	**MA.K.11.1 Sort objects or people according to stated attributes**	• Independently sorts objects or people in several ways, e.g., by color, by shape, by size, by use, etc., and explain how they are sorted.

Data Analysis, Statistics & Probability

CONTENT STANDARD #12	
Interpret data methods of exploratory data analysis	**Topic: Statistics**

Understanding(s): *Students will understand that…*
- Describing things as accurately as possible enables people to more effectively communicate their observations.
- Understanding data can lead to educated predictions and conclusions.
- Different representations of the same data are used for different purposes.
- Data helps people to understand situations and make informed decisions.
- Graphical displays of numbers make it possible to spot patterns that are not otherwise obvious.
- Sometimes, certain representations can be fashioned to be misleading.

Essential Questions:
- How does one represent, analyze, and communicate data to make informed decisions?

Knowledge: *Students will know…*
- Measures of central tendency (mean, median, mode).
- Range (spread of data).
- The same data can be represented and interpreted in different ways.

Skill(s): *Students will be able to…*
- Create stem and leaf, box and whisker, and scatter plots.
- Determine mean, median, and mode of a data set.
- Compare data sets.
- Interpret data displayed in a graph or table (e.g., trends).
- Describe data displayed in a graph or table (e.g., clusters, minimum, maximum, range, outliers, gaps).
- Use appropriate language to describe and interpret data.

Grade	Reference	Benchmark
Grade 8	MA.8.12.1	Recognize situations appropriate for scatter plots
	MA.8.12.2	Analyze different representations of the same data to describe how representations can be used to skew a person's interpretation of the data
Grade 7	MA.7.12.1	Relate the spread of a data set to a box-and-whisker plot
Grade 6	MA.6.12.1	Determine and interpret the measures of center (mean, median, mode) of a data set and explain what each measure indicates about the data set
	MA.6.12.2	Use a stem-and-leaf plot to analyze a set of data
Grade 5	MA.5.12.1	Determine the range, median, mode, and mean for a data set
	MA.5.12.2	Compare different representations of the same data and evaluate how well each representation shows important aspects of the data
Grade 4	MA.4.12.1	Compare related data sets (e.g., height of 4th grade boys vs. height of 4th grade girls) with an emphasis on how the data are distributed
	MA.4.12.2	Analyze important features in the shape of the graph of a data set
Grade 3	MA.3.12.1	Interpret data (e.g., tallies, chart, tables, bar graphs, line plots) and state what the representation shows about the set of data

Grade	Reference	Benchmark
Grade 2	MA.2.12.1	Interpret data displayed in a bar graph and describe how the important features of the data set are represented in a bar graph
Grade 1	MA.1.12.1	Interpret data using simple language (e.g., *more, less, fewer, equal*)
Grade K	-----	<no benchmark for this topic at this grade level>

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational Proficiency ←—————————→		**Approaching**			
Students will	**Students will**	**Students will**	**Students will**		**Students will**
Gr. 8		• Distinguish scatter plots from line graphs.	• Construct scatter plots given two sets of data.	• Recognize situations that involve displaying data using a scatter plot.	**MA.8.12.1 Recognize situations appropriate for scatter plots**	
			• Draw graphs with different scales on the vertical axis to show how data can be distorted.	• Compare two different representations of the same data and state how a person's interpretation may be influenced by the: o type of graph used (compare one type of graph to another type of graph using the same data). o way the axes are scaled (compare two graphs to each other with one of the graphs scaled differently).	**MA.8.12.2 Analyze different representations of the same data to describe how representations can be used to skew a person's interpretation of the data**	
Gr. 7	• Find the minimum, maximum, and median of a data set.	• Find the five-number summary of a data set, i.e., minimum, first quartile, median, third quartile, and maximum.	• Draw a box and whisker plot given the five-number summary.	• Draw a box and whisker plot using the five-number summary of a data set. • Show how each of the four quartile regions, i.e., the minimum value to the first quartile, the lower quartile to the median, the median to the upper quartile, and the upper quartile to the maximum value in the box and whisker plot represent one-fourth of the data set.	**MA.7.12.1 Relate the spread of a data set to a box and whisker plot**	

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational Proficiency ◄——————► **Approaching**					
Students will	Students will	Students will	Students will		Students will
	• Find the mean, median, and mode of a set of data. *NOTE: See MA.5.12.1.*	• Find the mean, median, and mode of a set of data. • Interpret which measure of center best represents the intended purpose for the data collection.	• Find the mean, median, and mode of a set of data. *NOTE: The data should be real data and not just a list of arbitrary numbers.* • Interpret which measure of center best represents the intended purpose for the data collection, e.g., if the median is 30 while the mean is 47 and the mode is 28, the student can explain why the mean is inflated compared to the median and mode. • Explain what the mean, median, and mode represents about the set of data.	**MA.6.12.1** **Determine and interpret the measures of center (mean, median, mode) of a data set and explain what each measure indicates about the data set**	

Gr. 6

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational Proficiency ⟵⟶	**Approaching**				
Students will	Students will	Students will	Students will		Students will
		• Find the following information from a stem and leaf plot: mean, median, mode, range.	• Find the following information from a stem and leaf plot: mean, median, mode, range. • State generalizations, e.g., if an outlier exists, the mean wouldn't be chosen, median or mode may be chosen to best represent the data based on a visual interpretation of the plot.	**MA.6.12.2** **Use a stem and leaf plot to analyze a set of data**	
			• Determine the range, median, mode, and mean of a given set of data.	**MA.5.12.1** **Determine the range, median, mode, and mean for a data set**	
Gr. 5		• Compare and contrast different representations of the same data, e.g., a bar graph with intervals of 10 vs. intervals of 20; a pictograph using pictures that are uneven in size, etc.	• Compare and evaluate (justify) how well each given representation shows the important parts of the data, e.g., histogram vs. line plot – both show where the mode(s) may be, and display a general range; differing intervals – if we wanted to distort the data between one category and another in a bar graph, we might use smaller intervals of 10, rather than 20, etc.	**MA.5.12.2** **Compare different representations of the same data and evaluate how well each representation shows important aspects of the data**	• Create two different representations of the same data to make the case for two opposing views, e.g., create bar graphs of the same data with intervals of 10 and intervals of 20. The intervals of 10 may be used to emphasize the difference between categories, whereas the intervals of 20 would be used to minimize the difference between categories.

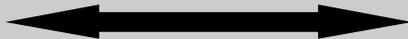| DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational Proficiency ⟵⟶ Approaching					
Students will	Students will	Students will	Students will		Students will
Gr. 4			• Compare two or more sets of related data (such as comparing the weekly growth of sunflowers vs. orchids, or comparing weekly allowances of fourth grade boys vs. girls) by: ○ Comparing the data organized in tables. ○ Graphing the data in a double bar or double line graph, e.g., the sunflowers have grown more than orchids. "There was no difference in the allowance between fourth grade boys and girls." "Since there were a lot more girls than boys, it was hard to really tell if the girls really liked ice cream more than the boys."	**MA.4.12.1** **Compare related data sets (e.g., height of 4th grade boys vs. height of 4th grade girls) with an emphasis on how the data are distributed**	• Compare mean, median, mode, range, clusters, gaps, etc. between the two data sets.
			• Look for features in a graph (such as rises, falls, patterns, outliers) that can lead to conclusions about the data. • Make statements about the data such as, "This part of the graph tells me…," or "I think…because in the graph…"	**MA.4.12.2** **Analyze important features in the shape of the graph of a data set**	

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational Proficiency ⟵⟶ Approaching					
	Students will	Students will	Students will	Students will		Students will
Gr. 3			• Answer questions about the data on various types of graphs, e.g., how many students like oranges? How many more students like oranges than apples?	• Use features in graphs, charts, and tables to interpret and describe the data (paying more attention to how the data is behaving; moving away from simply reading the graph, e.g., looking for peaks/dips, patterns, where the data clusters, etc.	**MA.3.12.1 Interpret data (e.g., tallies, chart, tables, bar graphs, line plots) and state what the representation shows about the set of data**	
Gr. 2				• Use features in a bar graph to interpret the data, paying particular attention to the tallest and shortest bars, gaps, bars of equal height, and other noticeable aspects of the graph.	**MA.2.12.1 Interpret data displayed in a bar graph and describe how the important features of the data set are represented in a bar graph**	
Gr. 1		• Describe the data without comparative language, e.g., there are 5 boys and 11 girls.	• Identify by pointing when asked which is less, more or equal for gathered data.	• Compare/contrast collected data by using words such as more, less, fewer, and equal.	**MA.1.12.1 Interpret data using simple language e.g., more, less, fewer, equal**	• Interpret data and explain, e.g., how many more? How much less?
Gr. K					**<no benchmarks for this grade level>**	

Data Analysis, Statistics & Probability

CONTENT STANDARD #13	
Develop and evaluate inferences, predictions, and arguments that are based on data	**Topic: Data Analysis**

Understanding(s): *Students will understand that…*	**Essential Question(s):**
• Data helps people to understand situations and make informed decisions. • Understanding data can lead to educated predictions, conclusions and further questions. • Data can be biased or skewed in a variety of ways and for different reasons.	• How does one use data to make valid predictions/decisions?
Knowledge: *Students will know…*	**Skill(s):** *Students will be able to…*
• Inference. • Conjecture.	• Design a study (determine population, sample, sample size, sampling method). • Make predictions/conjectures based on data. • Make inferences/conclusions.

Grade	Reference	Benchmark
Grade 8	MA.8.13.1	Make conjectures about possible relationships between two characteristics of a sample based on interpretations of scatter plots
Grade 7	MA.7.13.1	Formulate new questions that arise from previous conclusions or conjectures and plan a new study to answer them
Grade 6	MA.6.13.1	Make inferences about a population based on the interpretation of a sample data set
Grade 5	MA.5.13.1	Design studies to further investigate the conclusion/predictions made based on data
Grade 4	MA.4.13.1	Propose and justify conclusions/predictions based on data
Grade 3	MA.3.13.1	Answer questions based on data represented in graphs
Grade 2	-----	<no benchmark for this topic at this grade level>
Grade 1	-----	<no benchmark for this topic at this grade level>
Grade K	-----	<no benchmark for this topic at this grade level>

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational		Approaching Proficiency			
	Students will	**Students will**	**Students will**	**Students will**		**Students will**
Gr. 8			• Determine if a scatter plot shows positive, negative, or no correlation of the two variables graphed.	• Determine whether or not the data displayed in a scatter plot shows a relationship between the two variables.	**MA.8.13.1 Make conjectures about possible relationships between two characteristics of a sample based on interpretations of scatter plots**	
Gr. 7			• Ask new questions based on conclusions from a previous study or from previous conjectures.	• Formulate a new plan (or a follow-up plan) to address questions that arose from a completed study.	**MA.7.13.1 Formulate new questions that arise from previous conclusions or conjectures and plan a new study to answer them** *NOTE: Similar to MA.5.13.1*	
Gr. 6				• Form generalizations about the population based on the trends and patterns from the sample data set, e.g., if 10 out of 25 students in one class likes the color blue, the prediction for three classes would be that 30 out of 75 students like the color blue. • Consider possibility of the data being skewed based on the collection method and/or sample size.	**MA.6.13.1 Make inferences about a population based on the interpretation of a sample data set**	

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational ◄────► Approaching Proficiency					
	Students will	Students will	Students will	Students will		Students will
Gr. 5			• Formulate questions based on the results of a previous study.	• Design a new study that uses the information, predictions and conclusions made from a previous study of data.	**MA.5.13.1 Design studies to further investigate the conclusion/ predictions made based on data**	
Gr. 4		• Propose a conclusion/prediction based on the analysis.	• Analyze given data (it may be necessary to organize the data into a table and/or graph).	• Analyze given data (it may be necessary to organize the data into a table and/or graph). • Propose a conclusion/prediction based on the analysis. • Justify the conclusion/prediction with references to the data.	**MA.4.13.1 Propose and justify conclusions/ predictions based on data**	
Gr. 3				• Answer questions based on data represented in a graph, e.g., based on the bar graph, how many students like grape juice? (Five students)	**MA.3.13.1 Answer questions based on data represented in graphs**	
Gr. 2					**<no benchmarks for this grade level>**	
Gr. 1					**<no benchmarks for this grade level>**	
Gr. K					**<no benchmarks for this grade level>**	

Data Analysis, Statistics & Probability

CONTENT STANDARD #14	
Understand and apply basic notions of chance and probability	**Topic: Probability**

Understanding(s): *Students will understand that…*
- Data helps people to understand situations and make informed decisions.
- Probabilities give us an idea of what we expect should happen in the long run.
- Data can be biased or skewed in a variety of ways and for different reasons.

Essential Question(s):
- How does one apply the basic notions of chance and concepts of probability to make informed decisions?

Knowledge: *Students will know…*
- Theoretical probability.
- Experimental probability.
- Simple compound event.
- As the number of trials of an experiment or simulation increases, the experimental probability will approach the theoretical probability of the event.
- Probability of an event occurring can be represented by a fraction or decimal between zero and one inclusive, where zero means the event never happens and one means it always occurs.
- Probability of an event occurring can be represented by a percent between 0 and 100 inclusive.

Skill(s): *Students will be able to…*
- Compute probabilities of simple events.
- Compute probabilities of simple compound events.
- Determine all possible outcomes of a simple compound event.
- Determine theoretical probability.

Grade	Reference	Benchmark
Grade 8	MA.8.14.1	Judge the validity of conjectures that are based on experiments or simulations
Grade 7	MA.7.14.1	Relate theoretical probability to experimental results
Grade 6	MA.6.14.1	Compute probabilities of simple compound events (e.g., rolling two dice, using two different spinners at the same time)
Grade 5	MA.5.14.1	Use fractions, decimals, and percents to indicate the probability of events
Grade 5	MA.5.14.2	Determine all possible outcomes of a simple compound event
Grade 4	MA.4.14.1	Predict the probability of outcomes of simple experiments (e.g., coin toss, 4-colored spinner) and test the predictions
Grade 3	MA.3.14.1	Make reasonable predictions concerning the likelihood of an event occurring (e.g., certain, likely, unlikely, impossible)
Grade 2	-----	<no benchmark for this topic at this grade level>
Grade 1	-----	<no benchmark for this topic at this grade level>
Grade K	-----	<no benchmark for this topic at this grade level>

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational		**Approaching Proficiency**			
	Students will	**Students will**	**Students will**	**Students will**		**Students will**
Gr. 8			• List general causes that may bias or skew data, e.g., sampling methods in a survey, experiment, or simulation; set up of the simulation; procedure used in the experiment or simulation.	• Identify possible causes that may have biased or skewed the results of an experiment or simulation. • Judge the validity of conjectures that are based on experiments or simulations.	**MA.8.14.1** **Judge the validity of conjectures that are based on experiments or simulations**	
Gr. 7	• Define experimental and theoretical probability. • Determine the experimental probability of an event.	• Calculate theoretical probability of an event.	• Compare experimental to theoretical probability.	• Explain that as the number of trials increases, the experimental probability will approach the theoretical probability.	**MA.7.14.1** **Relate theoretical probability to experimental results**	
Gr. 6			• Determine the probability of two independent events happening at the same time by creating a list or table, e.g., bag A has a red, blue, and green marble, bag B has a red, blue, and green cube. If asked to randomly pull one item from each bag, what is the probability that both items are red? Possible solution strategy: Student **lists** all the possibilities: R-r, R-b, R-g, B-r, B-b, B-g, G-r, G-b, G-g. The probability that both are red is $\frac{1}{9}$.	• Compute the probability of two independent events happening at the same time, e.g., bag A has a red, blue, and green marble; bag B has a red, blue, and green cube. If asked to randomly pull one item from each bag, what is the probability that both items are red?). Solution: $\frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$	**MA.6.14.1** **Compute probabilities of simple compound events** **(e.g., rolling two dice, using two different spinners at the same time)**	

	DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
	Foundational		Approaching Proficiency			
	Students will	Students will	Students will	Students will		Students will
Gr. 5		• Use fractions between zero and one inclusive, to indicate the probability of events.	• Use percents between 0 and 100 to indicate the probability of events.	• State the probability of an event occurring as a fraction, decimal, and percent.	**MA.5.14.1 Use fractions, decimals, and percents to indicate the probability of events**	
				• List all of the possible outcomes that involve a simple compound event, e.g., given three different colored shirts and two different shorts, describe all six possible outfits. • Demonstrates an organized process to determine all possible outcomes, e.g., tree or visual representation.	**MA.5.14.2 Determine all possible outcomes of a simple compound event**	
Gr. 4		• Predict the outcome prior to conducting a simple experiment, e.g., flipping a coin ten times and predicting the coin will land on heads five times.	• Predict the outcome prior to conducting a simple experiment, e.g., flipping a coin ten times and predicting the coin will land on heads five times. • Conduct the experiment and collect data.	• Predict the outcome prior to conducting a simple experiment, e.g., flipping a coin ten times and predicting the coin will land on heads five times. • Conduct the experiment and collect data. • Validate the prediction based on data collected.	**MA.4.14.1 Predict the probability of outcomes of simple experiments (e.g., coin toss, 4-colored spinner) and test the predictions**	

DEVELOPMENTAL LEVELS			PROFICIENT	BENCHMARK	ADVANCED
Foundational ⟷ Approaching Proficiency					
Students will	Students will	Students will	Students will		Students will
Gr. 3				• Predict the probability of something happening as certain, likely, unlikely, or impossible.	**MA.3.14.1 Make reasonable predictions concerning the likelihood of an event occurring (e.g., certain, likely, unlikely, impossible)**	• Provide a reasonable explanation for the prediction.
Gr. 2					**\<no benchmarks for this grade level\>**	
Gr. 1					**\<no benchmarks for this grade level\>**	
Gr. K					**\<no benchmarks for this grade level\>**	