MAP Mathematics Expectations

Data and Measurement

K.6 Compare the length, weight, and capacity (volume) of objects.

K.6a Make direct comparisons between objects (e.g., recognize which is shorter, longer, taller, lighter, heavier, or holds more).

K6.b Estimate length, weight, and capacity, and check estimates with actual measurements.

- Select and use appropriate measurement tools (rulers, tape measures, scales, containers, clocks, thermometers).
- Relate direct comparisons of objects to comparisons of numerical measurements or estimates.

  Example: Tom, who is four feet tall, is shorter than Jose, who is five feet tall, because 4 is smaller than 5.

K.7 Recognize and use words that represent time, temperature, and money.

K.7a Recognize and use the words *day, night, morning, afternoon, evening, yesterday, today, tomorrow*.

- Identify daily landmark times such as *bedtime* or *lunch time*.

K.7b Recognize the role of clocks and calendars in measuring and keeping track of time.

K.7c Know that thermometers measure temperature, and that *degree* is the word used to name a temperature.

K.7d Identify U.S. coins by name.

Data and Measurement

1.4 Measure length, weight, capacity, time, and money.

1.4a Use rulers, scales, and containers to measure and compare the dimensions, weight, and capacity (volume) of classroom objects.

Note: The concepts of addition and order are intrinsic in quantities such as length, weight and volume (capacity). So measuring such quantities provides an independent empirical basis for understanding the properties of numbers that is different from simple counting.

- Round off measurements to whole numbers.
- Recognize the essential role of units in measurement, and understand the difference between *standard* and *non-standard* units.

  Example: An inch or foot marked on a ruler is a standard unit, whereas a paperclip or a classmate's foot used to measure is a non-standard unit.
- Represent addition by laying rods of different lengths end to end, combining items on a balance, and pouring liquids or sand into different containers.
- Estimate lengths with simple approximations.
- Understand and use comparative words such as *long, longer, longest; short, shorter, shortest; tall, taller, tallest; high, higher, highest*.

1.4b Tell time from analog (round) clocks in half-hour intervals.

- Use the expressions "o'clock" and "half past."

1.4c Count, speak, write, add, and subtract amounts of money in cents up to $1 and in dollars up to $10.

- Know the values of US coins (penny, nickel, dime, quarter, dollar bill).
- Use the symbols $ and ¢ separately (e.g., $4, 35¢ instead of $4.35).
- Use coins to decompose monetary amounts given in cents.

  Example: 17¢ = one dime, one nickel, and two pennies = 10 + 5 + 1 + 1; or 17¢ = three nickels and two pennies = 5 + 5 + 5 + 1 + 1.
- Understand and solve money problems expressed in a different ways, including *how much more* or *how much less.*

  Note: Avoid problems that require conversion from cents to dollars or vice versa.

1.5 Use picture graphs to pose and solve problems.

1.5a Interpret picture graphs in words (orally) and with numbers.

- Answer questions about the meaning of picture graphs.

1.5b Create picture graphs of counts and measurements from collected or provided data.

- Represent data both in horizontal and vertical forms.
- Label axes or explain what they represent
- Pose and answer comparison questions based on picture graphs.

Data and Measurement

2.5 Add, subtract, compare, and estimate measurements.

2.5a Estimate, measure, and calculate length in meters, centimeters, yards, feet, and inches.

- Recognize and use standard abbreviations: m, cm, yd, ft, and in, as well as the symbolic notation 3'6".
- Understand and use units appropriate to particular situations.

  Example: Standard U.S .school notepaper is sized in inches, not centimeters.
- Add and subtract mixed metric units (e.g., 8m,10cm + 3m,5cm) but defer calculation with mixed English units (e.g., 3ft,1in + 1ft,8in) until third grade.

  Note: Conversion between systems awaits a later grade.

2.5b Measure the lengths of sides and diagonals of common two-dimensional figures such as triangles, rectangles (including squares) and other polygons.

- Measure to the nearest centimeter or half inch using meter sticks, yardsticks, rulers, and tape measures marked in either metric or English units.

  Note: Measure *within* either system without conversion between systems.
- Create and use hand-made rulers by selecting an unconventional unit length (e.g., a hand-width), marking off unit and half-unit lengths.
- Explore a variety of ways to measure perimeter and circumference.

  Examples: Encircle with a tape measure; measure and sum various pieces; wrap with a string and then measuring the length of the string. Compare answers obtained by different strategies and explain any differences.

  Note: Comparing the result of a direct measurement (encircling) with that of adding component pieces underscores the importance of accuracy and serves as a prelude to understanding the significance of significant digits.

2.5c Estimate and measure weight and capacity in common English and metric units.

- Recognize, use, and estimate common measures of volume (quarts, liters, cups, gallons) and weight (pound, kilogram).
- Understand and use common expressions such as *half a cup* or *quarter of a pound* that represent fractional parts of standard units of measurement.

2.5d Compare lengths, weights, and capacities of *pairs* of objects.

- Demonstrate that the combined length of the shorter pieces from two pairs of rods is shorter than the combined lengths of the two longer pieces.
- Recognize that same applies to combined pairs of weights or volumes.

  Note: Even though this relation may seem obvious, it is an important demonstration of the fundamental relation between addition and order, namely, that if $a \leq b$ and $c \leq d$, then $a+c \leq b+d$.

2.6 Tell, estimate, and calculate with time.

2.6a Tell, write, and use time measurements from analogue (round) clock faces and from digital clocks and translate between the two.

- Round off to the nearest five minutes.
- Understand and use different ways to read time, e.g., "nine fifteen" or "quarter past nine"; "nine fifty" or "ten to ten."
- Understand a.m. and p.m.

2.6b Understand the meaning of time as an interval, and be able to estimate the passage of time without clock measurement.

2.6c Understand and use comparative phrases such as "in fifteen minutes," "half an hour from now," "ten minutes late."

2.7 Count, add, and subtract money.

2.7a Read, write, add, and subtract money up to ten dollars.

- Handle money accurately and make change for amounts of $10 or less by counting up.
- Use the symbols $ and ¢ properly
- Recognize and use conventional ("decimal") monetary notation and translate back and forth into $ and ¢ notation.
- Add and subtract monetary amounts in both $ and ¢ and conventional notation.
- Use a calculator to check monetary calculations, and also to add lists of three or more amounts.
- Estimate answers to check for reasonableness of hand or calculator methods.

2.8 Represent measurements by means of bar graphs.

2.8a Collect data and record them in systematic form.

2.8b Select appropriate scales for a graph, and make them explicit in labels.

- Employ both horizontal and vertical configurations.
- Recognize an axis with a scale as a representation of the number line.
- Compare scales on different graphs.
- Use addition and subtraction as appropriate to translate data (gathered or provided) into measurements required to construct a graph.

2.8c Create and solve problems that require interpretation of bar or picture graphs.

Data and Measurement

3.7 Recognize why measurements need units and know how to use common units.

3.7a Understand that all measurements require units and that a quantity accompanied by a unit represents a measurement.

- Know and use the names and approximate magnitudes of common units:
  - -- For length: kilometer, meter, centimeter; mile, yard, foot, inch.
  - -- For capacity: liter, milliliter; gallon, quart, pint, cup.
  - -- For time: year, month, week, day, hour, minute, second.
  - -- For money: pennies, nickels, dimes, quarters, dollars.

Note: Many of these units have been introduced in prior grades; others will be introduced in later grades. Here some are pulled together for reinforcement and systematic use. Each year in grades 2-6 some new measures should be introduced, and previous ones reinforced. Which are done in which grades is of lesser importance.

3.7b Know common within-system equivalences:

- 1 meter = 100 centimeters, 1 yard = 3 feet, 1 foot = 12 inches.
- 1 liter = 1,000 milliliters, 1 gallon = 4 quarts, 1 quart= two pints.
- 1 year = 12 months, 1 week = 7 days, 1 hour = 60 minutes, 1 minute = 60 seconds.
- 1 dollar = 4 quarters = 10 dimes = 100 pennies, 1 quarter= 5 nickels = 25 pennies, 1 dime = 2 nickels = 10 pennies, 1 nickel = 5 pennies.

3.7c Choose reasonable units of measure, estimate common measurements, use appropriate tools to make measurements, and record measurements accurately and systematically.

- Make and record measurements that use mixed units within the same system of measurement (e.g., feet and inches, hours and minutes).

Note: Many situations admit various approaches to measurement. Using different means and comparing results is a valuable activity.

- Understand that errors are an intrinsic part of measurement.
- Understand and use time both as an absolute (12:30 pm) and as duration of a time interval (20 minutes).
- Understand and use idiomatic expressions of time (e.g., "10 minutes past 5," "quarter to 12," "one hour and ten minutes").

3.7d Use decimal notation to express, add, and subtract amounts of money.

Note: Dealing with money enables students to become accustomed to decimal notation, i.e., $1.49 + $0.25 = $1.74.

3.7e Solve problems requiring the addition and subtraction of lengths, weights, capacities, times, and money.

- Include use of common abbreviations: m, cm, kg, g, l, ml, hr, min, sec, in, ft, lb, oz, $, ¢.

Note: Add and subtract only within a single system, using quantities within students' experience. Use real data where possible, but limit the size and complexity of numbers so that problem solving, not computation, is the centgral challenge of each task.

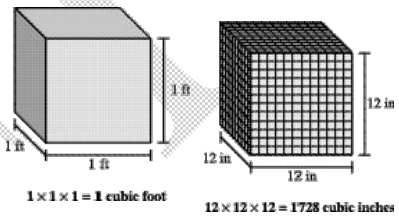
Data and Measurement

4.9 Understand and use standard measures of length, area, and volume.

4.9a Know and use common units of measure of length, area, and volume in both metric and English systems.

- Always use units when recording measurements.
- Know both metric and English units: centimeter, square centimeter, cubic centimeter; meter, square meter, cubic meter; inch, square inch, cubic inch; foot, square foot, cubic foot.
- Use abbreviations: m, cm, in, ft, yd; m^2, cm^2, in^2, ft^2, yd^2; sq m, sq cm, sq in, sq ft, sq yd; m^3, cm^3, in^3, ft^3, and yd^3.

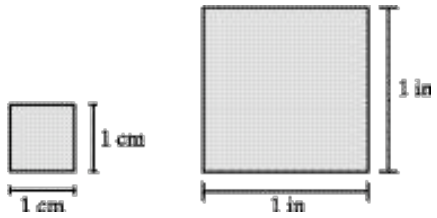
4.9b Convert measurements of length, weight, area, volume, and time within a single system.



Note: Emphasize conversions that are common in daily life. Common conversions typically involve adjacent units, for example, hours and minutes or minutes and seconds, but not hours and seconds. Know common within-system equivalences.

- Use unit cubes to build solids of given dimensions and find their volumes.
- 1 square foot = 12^2 square inches; 1 square meter as 100^2 square centimeters; 1 cubic foot = 12^3 cubic inches; 1 cubic meter as 100^3 cubic centimeters.

4.9c Visualize, describe, and draw the relative sizes of length, area, and volume units in the different measurement systems.



- Estimate areas of rectangles in square inches and square centimeters.

Note: Avoid between-system conversions.

Examples: Centimeter vs. inch, foot and yard vs. meter; square centimeter vs. square inch; square yard vs. square meter; cubic foot vs. cubic meter.

4.9d Recognize that measurements are never exact.

- Both recorded data and answers to calculations should be rounded to a degree of precision that is reasonable in the context of a given problem and the accuracy of the measuring instrument.

Note: All measurements of continuous phenomena such as length, capacity or temperature are approximations. Measurements of discrete items such as people or bytes can be either exact (e.g. size of an athletic team) or approximate (e.g., size of a city).

4.9e Solve problems involving area, perimeter, surface area, or volume of rectangular figures.

- Select appropriate units to make measurements on everyday objects, record measurements to reasonable degree of accuracy, and use a calculator when appropriate to compute answers.
- Know that answers to measurement problems require appropriate units in order to have any meaning.

Note: Include figures whose dimensions are given as fractions or mixed numbers.

4.10. Record, arrange, present, and interpret data using tables and various types of graphs.

4.10a Create and interpret line, bar, and circle graphs and their associated tables of data.

- Create and label appropriate scales for graphs.
- Prepare labels or captions to explain what a table or graph represents.
- Solve problems using data presented in graphs and tables.
- Employ fractions and mixed numbers, as needed, in tables and graphs.

Data and Measurement

5.9 Make, record, display, and interpret measurements of everyday objects.

5.9a Select appropriate units to make measurements, and include units in answers.

5.9b Recognize and use measures of weight, information, and temperature.

- For information: bytes, kilobytes (K, or Kb), megabytes (M), gigabytes (G). 1G = 1000M, 1M = 1000K, 1K = 1000 bytes.

  ***Note**:* Literally, the multiplier is 1024 = 2^{10}, but for simplicity in calculation 1000 is generally used instead.
- For weight: kilogram (kg), gram (g), pound (lb), ounce (oz). 1 kg= 1000 g, 1 lb = 16 oz.
- For temperature: Centigrade and Fahrenheit degrees. 32° F = 0° C; 212° F = 100° C.

5.9c Record measurements to reasonable degree of accuracy, using fractions and decimals as needed to achieve the desired detail.

5.9d When needed, use a calculator to find answers to questions associated with measurements.

- Understand the role of significant digits in signaling the accuracy of measurements and associated calculations.

  Example: Report a city's population as 210,000, not as 211,513.

5.9e Create graphs and tables to present and communicate data.

5.10 Find, interpret, and use the average (mean) of a set of data.

5.10a Calculate the average of a set of data that includes whole numbers, fractions, and decimals.

***Note**:* Emphasize that *data* is plural and *datum* is singular, the name for a single number in a set of data.

- Infer characteristics of a data set given the mean and other incomplete information.

Data and Measurement

6.6 Understand the meaning of probability and how it is expressed.

6.6a The probability of an event is a number between zero and one that expresses the likelihood of an occurrence.

- The probability of an occurrence is the ratio of the number of actual occurrences to the number of possible occurrences
- Understand different ways of expressing probabilities--as percentages, decimals, or odds.

  Example: If the probability of rain is .6, the weather forecaster could say that there is a 60% chance of rain, or that the odds of rain are 6:4 (or 3:2).
- If p is the probability that an event will occur, then $1-p$ is the probability that it will not occur.

  Example: If the probability of rain is 60%, then the probability that it will not rain is 100% -60% = 40%. (Equivalently, 1 - .60 = .40)

Data and Measurement

7.4 Collect, organize, and analyze both single variable and two-variable data.

7.4a Find and interpret the mean (average), median, upper-, lower-, and inner-quartile range of a set of data.

- Prepare and interpret box-and-whisker plots and stem-and-leaf plots.

7.4b Interpret and employ various graphs and charts to represent data faithfully.

- Select suitable graph type (e.g., bar graphs, line graphs, circle graphs (pie charts), scatter plots, box-and-whisker plots, and stem-and-leaf plots) and use it to create accurate representations of given data.

  Note: All but the last two types have been introduced in earlier grades.

- Interpret and solve problems using information presented in these various visual forms.

7.4c Create and interpret scatter plots.

- Understand the difference between apparent association observed in a scatter plot and legitimate cause and effect.

Data and Measurement

8.2 Understand the relationship between probability and relative frequencies.

8.2a Understand, compute, and graph relative and cumulative frequencies

- Calculate probabilities of events for simple experiments with equally probable outcomes.

  Examples: Tossing dice, flipping coins, spinning spinners.

- Compare probabilities of two or more events and recognize when certain events are equally likely.

8.2b Solve simple problems involving probability and relative frequency.

- If an action (e.g., throwing a die) is repeated *n* times and a certain event (e.g., coming up 5) occurs *b* times, the ratio b/n is the called the *relative frequency* of the event occurring.

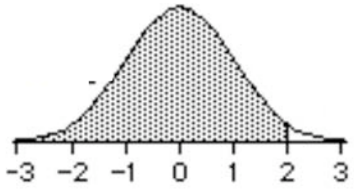
  Note: With increasing numbers of trials relative frequency is increasingly likely to be a good approximation to the true probability, but even a large number of trials might not produce a relative frequency very close to the true probability. (Relative frequency is often called *empirical* or *experimental probability* in contrast with *theoretical probability.)*

- Recognize common misconceptions associated with dependent and independent event

  Examples: Lotteries, "hot streaks."

8.2c Interpret main features of the graph of the normal distribution.

- Understand common examples that fit the normal distribution (e.g., height, weight).
- Recognize that approximately 2/3 of the cases fall in the middle third of the range of the graph, and that 95% of the cases fall in the middle two-thirds of the range of the graph.



8.3 Understand and use ratios, derived quantities, and indirect measurements.

8.3a Solve data problems using ratios, rates, and percentages.

- Understand simple and compound interest.

8.3b Understand and use ratio and multiplicative quantities.

- Ratio quantities include
  -- velocity, measured in units such as miles per hour (mph);
  -- density, measured in units such as kilograms per liter (kg/l);
  -- pressure, measured in units such as pounds per square foot (lb/ft^2);
  -- population density, measured in units such as persons per square mile.
- Multiplicative quantities include
  -- area, measured in units such as square feet (ft^2);
  -- volume, measured in units such as cubic meters (m^3);
  -- energy, measured in units such as kilowatt hours (kw-h);
  -- work, measured in units such as person-days.
- Make within-system conversions of derived quantities.

  Examples: Feet per second to miles per hour; square feet to square inches.

8.3c Plan and carry out direct and indirect measurements.

- Use similarity and shadows to make indirect measurements.
- Understand how the precision of measurement influences accuracy of quantities derived from these measurements.

  Note: Analysis of accuracy assumes that measurement errors are small relative to the quantity being measured, as they should be unless an error arises in transcription or data entry.

  Example*:* When calculating an area *A* by means of the product *bh*, if the measurement uncertainty for both b and h is ±*x*%, then the uncertainty in A is at most ±2x%. For cubes, an x% error in linear measurements yields about ±3x% error in the volume calculation.

8.3d Understand the behavior of derived measurements such as weighted averages and percentage change.

- Recognize instances of weighted averages such as the average grade of students in a school district, the average salary of NBA players, and the consumer price index (CPI).

8.3e Use ratios to create and interpret scale drawings as a tool for solving problems.