Mathematical Processes Standard

Students use mathematical processes and knowledge to solve problems. They apply the mathematical processes as they learn content from the other mathematical standards.

Grade 7 Indicators	Grade 8 Indicators	
Problem Solving 1. Apply and adapt a variety of appropriate strategies to solve problems: • create a mathematical model • draw a picture • act it out • look for a pattern • guess and check • make an organized list • make a simpler but similar problem • work backwards • use a formula • make a scale drawing • make and state assumptions 2. Understand when estimation, mental arithmetic, or paper and pencil calculation is more appropriate than technology. 3. Use an appropriate tool when the numbers are not easily calculated mentally, when an exact answer is needed, or when computation involves several numbers. 4. Consider alternative strategies and/or blend strategies. **Reasoning and Proof** 1. Use models and logic to make conclusions. 2. Adjust models as needed. 3. Reason inductively by identifying patterns. 4. Evaluate and analyze the mathematical thinking and strategies of others, orally and in writing. 5. Include enough detail and clarity that the reader/listener can follow the explanation. 6. Make multiple trials using manipulatives, drawings or paper and pencil. 7. Look for a case that doesn't work; e.g., a counter-example. 8. Recognize the characteristics of an acceptable	**Problem Solving** 1. Apply and adapt a variety of appropriate strategies to solve problems: • create a mathematical model • draw a picture • act it out • look for a pattern • guess and check • make an organized list • make a simpler but similar problem • work backwards • use a formula • make a scale drawing • make and state assumptions • consider extensions and variations to the problem and solution 2. Understand when estimation, mental arithmetic, or paper and pencil calculation is more appropriate than technology. 3. Use an appropriate tool when the numbers are not easily calculated mentally, when an exact answer is needed, or when computation involves several numbers. 4. Consider alternative strategies and/or blend strategies. **Reasoning and Proof** 1. Use models and logic to make conclusions. 2. Adjust models as needed. 3. Reason inductively by identifying patterns. 4. Evaluate and analyze the mathematical thinking and strategies of others, orally and in writing. 5. Include enough detail and clarity that the reader/listener can follow the explanation. 6. Make multiple trials using manipulatives, drawings or paper and pencil. 7. Look for a case that doesn't work; e.g., a counter-	

Grade 7 Indicators	Grade 8 Indicators	
argument/proof.	example.	

Grade 7 Indicators

argument/proof.

Communication
1. Use developmentally appropriate mathematical language and vocabulary.
2. Respond to instructions orally, visually and in writing as appropriate; e.g., tell, share, describe, demonstrate, compare, discuss, write.
3. Respond clearly with sufficient detail so that thinking can be understood.
4. Present thinking in a logical and organized in manner and explain to others how a problem was solved.
5. Read and reread all of the given information and instructions to ensure understanding; e.g., identify key information needed to solve the problem.
6. Interpret and summarize information from charts and graphs providing appropriate detail; e.g., describe patterns and contrasts.
7. Communicate mathematical learning by combining various representations; e.g., words with diagrams, charts and graphs with verbal descriptions.
8. Use the symbolic language of mathematics correctly, e.g. using = between two equal expressions, use $\angle$ to name angles.

Connections
1. Use learning from one area of mathematics to understand another.
2. Relate new and prior knowledge to make sense of new concepts being learned.
3. Make connections between mathematics and everyday life.
4. Apply a strategy or reference system that draws on previous learning in another context.
5. Make connections between different representations; e.g., numeric, graphical, and/or algebraic.

Representation
1. Select an appropriate representation of a mathematical idea or situation:
   • physical model/manipulative
   • picture/drawing/diagram

Grade 8 Indicators

example.

8. Recognize the characteristics of an acceptable argument/proof.
9. Follow and understand an argument or proof presented by someone else.

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2. Respond to instructions orally, visually and in writing as appropriate; e.g., tell, share, describe, demonstrate, compare, discuss, write.
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Mathematical Processes – Standard A
GRADE 8

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Grade 7 Indicators	Grade 8 Indicators	
- numerical - geometric - graphical - table/chart - graphical organizers/Venn diagram - equation/algebraic expression/formula - scale drawing - algorithm/logic model 2. Understand that more than one representation can be used to appropriately represent the same mathematical idea or situation. 3. Use multiple representations, as required; e.g., table/chart, graph. 4. Understand that there may be different variations of one representation; e.g., *2l +2w* is the same as *2(l + w)*. 5. Understand the role of constants and variables in formulas and patterning rules. **Reflection** 1. Reflect on mathematical concepts that have been learned using drawings, pictures and/or words: e.g., as a class group discussion and activity, create a simple classroom chart to show what has been learned. 2. In a math journal reflect on mathematical concepts that have been learned using drawings, pictures, math symbols, vocabulary, and language appropriate to the topic. Use writing prompts such as: - What did you do in math today? - What did you learn in math today? - Was what you learned easy or difficult? - What did you like or dislike about today's lesson? - What are some of the math words you used today? - What did you not understand in math today? - Describe uses for what you learned in math today.	**Representation** 1. Select an appropriate representation of a mathematical idea or situation: - physical model/manipulative - picture/drawing/diagram - numerical - geometric - graphical - table/chart - graphical organizers/Venn diagram - equation/algebraic expression/formula - scale drawing - algorithm/logic model 2. Understand that more than one representation can be used to appropriately represent the same mathematical idea or situation. 3. Use multiple representations, as required; e.g., table/chart, graph. 4. Understand that there may be different variations of one representation; e.g., *2l +2w* is the same as *2(l + w)*. 5. Understand the role of constants and variables in formulas and patterning rules. **Reflection** 1. Reflect on mathematical concepts that have been learned using drawings, pictures and/or words: e.g., as a class group discussion and activity, create a simple classroom chart to show what has been learned. 2. In a math journal reflect on mathematical concepts that have been learned using drawings, pictures, math symbols, vocabulary, and language appropriate to the topic. Use writing prompts such as: - What did you do in math today? - What did you learn in math today? - Was what you learned easy or difficult? - What did you like or dislike about what you learned? - What are some of the math words you used	

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Grade 7 Indicators	Grade 8 Indicators	
	today? • What did you not understand in math today? • Describe uses for what you learned in math today.	

Numbers, Number Sense and Operations Standard

Students demonstrate number sense, including an understanding of number systems and operations and how they relate to one another. Students compute fluently and make reasonable estimates using paper and pencil, technology-supported and mental methods.

Grade 7 Indicators	Grade 8 Indicators	
1. Read and write large numbers in standard form and in scientific notation.	1. Explain the meaning of exponents that are negative or 0.	
2. Use the order of operations to simplify numerical expressions, with and without grouping symbols and exponents.	2. Read and write large numbers and numbers between zero and one in scientific notation.	
3. Identify and apply the commutative, associative, distributive, identity and zero properties for addition and multiplication.	3. Add, subtract, multiply, divide and compare numbers written in scientific notation,	
4. Demonstrate fluency with adding, subtracting, multiplying and dividing fractions and mixed numbers.	4. Apply the order of operations to simplify expressions and perform computations involving integer exponents and radicals.	
5. Change percents to fractions and decimals.	5. Use the inverse and identity properties to solve equations.	
6. Use >, <, ≥, ≤, = to compare and order fractions, decimals and percents.	6. Recognize perfect square numbers and their roots up to 900 (30 x 30).	
7. Work flexibly with fractions, decimals, and percents to solve problems.	7. Approximate the square root of non-perfect square numbers; e.g., the square root of 200 is between 14 and 15.	
8. Develop meaning for percents greater than 100 and less than 1.	8. Write square roots in simplest form; e.g., $$\sqrt{576} = 24, \quad \sqrt{40} = \sqrt{4x10} = 2\sqrt{10} .$$	
9. Estimate, compute and solve problems involving proportions.	9. Perform computations (+, -, x, ÷) involving square roots.	
10. Find a number (whole) when a percent of it is known; e.g., the number 24 is 40% of _____.	10. Demonstrate fluency with performing computations involving integers and rational exponents.	
11. Find the percent (%) one number is of another; e.g., 24 is _____ % of 60.	11. Recognize that natural numbers, whole numbers, integers, rational numbers and irrational numbers are subsets of the real number system.	
12. Find a percent (part) of a number; e.g., 40% of 60 is _____.		
13. Compute discount, rate of discount, and sale		

Grade 7 Indicators	Grade 8 Indicators	
prices. 14. Find the <u>total cost</u> of an item or service including sales tax and/or tip. 15. Compute total cost of an item bought on an <u>installment plan</u>. 16. Compute percent increase and percent decrease. 17. Compute <u>commission</u>, <u>sales</u>, and <u>rate of commission</u>. 18. Complete a household <u>budget</u>, write checks and deposits, and balance a checkbook. 19. Describe the difference between <u>rational</u> and <u>irrational numbers</u>. 20. Use >, <, and = to compare <u>integers</u>. 21. Explain the meaning and effect of adding, subtracting, multiplying and dividing integers; e.g., how adding two integers can result in a lesser value. 22. Simplify <u>numerical expressions</u> involving integers and use integers to solve real-life problems. 23. Use the <u>order of operations</u> and <u>properties</u> to simplify numerical expressions involving integers, fractions and decimals. 24. Define and use the symbol for <u>absolute value</u>. 25. Recognize <u>perfect square numbers</u> and their <u>roots</u> up to 400 (20 x 20). 26. Approximate the square root of non-perfect square numbers; e.g., the square root of 130 is between 11 and 12. 27. Write square roots in simplest form; e.g., $\sqrt{225} = 15,\qquad \sqrt{27} = \sqrt{9x3} = 3\sqrt{3}$	12. Explain and use the inverse and identity properties and use inverse relationships (addition/subtraction, multiplication/division, squaring/square roots) in problem solving situations. 13. Determine when an estimate is sufficient and when an exact answer is needed in problem situations, and evaluate estimates in relation to actual answers; e.g., very close, less than, greater than. 14. Estimate, compute and solve problems involving rational numbers, including ratio, proportion and percent, and judge the reasonableness of solutions.	

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Numbers, Number Sense and Operations – Standard B
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Grade 7 Indicators	Grade 8 Indicators	
28. Estimate, compute and solve problems involving proportions, scaling, ratios, absolute value, square roots and exponents.		

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Numbers, Number Sense and Operations - Standard B
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Measurement Standard

Students estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools and technologies.

Grade 7	Grade 8	
1. Identify, use, and perform operations with both <u>metric</u> and <u>customary</u> units of measure. 2. Understand relationships among units and convert from one to another within same system to include <u>linear</u> measurement, <u>area</u> and <u>volume</u>; e.g., feet to yards, square feet to square yards, cubic feet to cubic yards. 3. Compare <u>Fahrenheit</u> temperature to <u>Celsius</u> temperature and know basic conversions. 4. Use appropriate levels of precision when estimating and calculating with measurements. 5. Develop and use formulas to determine area of triangles, parallelograms, and trapezoids. 6. Use formulas for determining the circumference and area of circles and to determine the area of <u>sectors</u>; e.g., ½ circle, ⅓ circle. 7. Develop and use formulas to find the <u>surface area</u> and <u>volume</u> of prisms, cylinders, and pyramids. 8. Develop strategies to find the area of <u>composite shapes</u> using the areas of squares, rectangles, triangles, parallelograms, circles, and <u>sectors</u>. 9. Explain the difference between surface area and volume and demonstrate that two objects may have the same surface area, but different volumes or vice versa. 10. Describe what happens to the surface area and volume of a three-dimensional figure when the measurements are changed; e.g., length of sides are doubled or halved.	1. Identify, use, compare, and perform operations with both <u>metric</u> and <u>customary</u> units of measure. 2. Convert units from one measuring system to another; e.g., lbs. to kg, inches to cm, liters to gallons, miles to kilometers. 3. Develop and use formulas to convert <u>Fahrenheit</u> temperatures to <u>Celsius</u> temperatures. 4. Use appropriate levels of precision when estimating and calculating with measurements and explain reasoning in writing. 5. Select appropriate methods for estimating measurements. 6. Find the area of <u>composite shapes</u> and <u>complex shapes</u> using the areas of squares, rectangles, triangles, parallelograms, trapezoids and circles. 7. Derive and justify formulas for <u>surface area</u> and <u>volume</u> using geometric models and common materials. 8. Develop and use formulas to find the surface area and volume of prisms, cylinders, pyramids, cones and spheres using <u>geometric models</u>, <u>geometric nets</u> and common materials. 9. Solve and determine the reasonableness of the results for problems involving <u>distance</u>, <u>rate</u>, and <u>time</u>. 10. Apply proportional reasoning to solve problems involving <u>indirect measurements</u> or rates. 11. Find the sum of the <u>interior</u> and <u>exterior angles</u> of regular <u>convex polygons</u> with and without measuring the angles with a protractor.	

Grade 7	Grade 8	
11. Select appropriate units for measuring derived measurements; e.g., miles per hour, revolutions per minute. 12. Use proportions to make and read scale drawings and models.	12. Use proportions to make and read scale drawings and models.	

Geometry and Spatial Sense Standard

Students identify, classify, compare and analyze characteristics, properties and relationships of one-, two- and three-dimensional geometric figures and objects. Students use spatial reasoning, properties of geometric objects, and transformations to analyze mathematical situations and solve problems.

Grade 7 Indicators	Grade 8 Indicators	
1. Determine when one set of figures is a <u>subset</u> of another; e.g., all squares are rectangles.	1. Build 3D models of <u>prisms, cylinders, pyramids,</u> and <u>cones</u> and investigate their properties.	
2. Develop a set of properties that eliminate all but the desired figure; e.g., only squares are quadrilaterals with all sides congruent and all angles congruent.	2. Identify and draw nets for a variety of <u>prisms, pyramids, cylinders</u> and <u>cones.</u>	
3. Recognize and define <u>complementary</u> and <u>supplementary angles</u>.	3. Define and use the terms <u>parallel</u>, <u>perpendicular</u>, and <u>transversal.</u>	
4. Construct congruent line segments and angles using a <u>compass</u> and a <u>straight edge</u>.	4. Define and identify types of angles; <u>adjacent</u>, <u>vertical</u>, <u>alternate interior</u>, <u>alternate exterior</u>, <u>and corresponding.</u>	
5. <u>Bisect</u> line segments and angles using a <u>compass</u> and <u>straight</u> <u>edge.</u>	5. Determine the angle measures of angles created by parallel lines and a transversal.	
6. Build 3D models of <u>prisms, cylinders, pyramids,</u> investigate their properties and identify their <u>nets</u>.	6. Apply theorems about the sum of <u>interior</u> and <u>exterior</u> <u>angles</u> of regular polygons.	
7. Draw representations of three-dimensional geometric objects from different views.	7. Understand and use the <u>Pythagorean Theorem</u> formula to solve problems involving right triangles.	
8. Apply <u>theorems</u> about the sum of interior angles of <u>regular polygons</u>; e.g., determine the sum of interior angles of a regular pentagon.	8. Find the missing side lengths of a <u>45-45-90 degree triangle</u> given the length of one side.	
9. Determine the measure of each interior angle of a regular polygon.	9. Find the missing side lengths of a <u>30-60-90 degree triangle</u> given the length of one side.	
10. Use <u>proportional reasoning</u> to describe and express relationships between parts and attributes of <u>similar</u> and <u>congruent</u> <u>figures</u>.	10. Define, locate, and draw images of figures by <u>translation</u>, <u>reflection</u>, <u>rotation,</u> and <u>scaling</u>.	
11. Determine and use <u>scale factors</u> for similar figures to solve problems using proportional reasoning.	11. Draw the results of <u>translations</u>, <u>reflections</u>, <u>rotations</u> and <u>dilations</u> of objects in a coordinate plane.	
12. Perform <u>translations</u>, <u>reflections</u>, <u>rotations</u> and <u>dilations</u> of two-dimensional figures using a variety of	12. Represent and analyze shapes using <u>coordinate geometry</u>; e.g., given three vertices and the type of quadrilateral, find the coordinates of the fourth vertex.	

Grade 7 Indicators	Grade 8 Indicators	
methods; e.g., paper folding, tracing, graph paper. 13. Explore the meaning of and use the <u>Pythagorean Theorem</u> to find the missing side length of a right triangle given the other two sides. 14. Apply properties of <u>congruent or similar triangles</u> to solve problems involving missing side lengths and angle measures.	13. Use proportions in several forms to solve problems involving similar figures (<u>part to part</u>, <u>part to whole</u>, <u>corresponding sides between figures</u>).	

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Geometry and Spatial Sense – Standard D
GRADE 8

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Patterns, Functions and Algebra Standard

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities, Students analyze, model and solve problems using various representations such as tables, graphs and equations.

Grade 7 Indicators	Grade 8 Indicators	Grade 8 Indicators
1. Represent and analyze patterns, rules and functions with words, tables, graphs, and simple variable expressions 2. Use words and symbols to describe arithmetic and geometric patterns and be able to find the next term of a pattern. 3. Recognize and explain when numerical patterns are <u>linear</u> or <u>nonlinear</u> progressions; e.g., 1,3,5,7... is linear and 1, 3, 4, 8, 16... is nonlinear. 4. Identify, formulate, and graph functions with graph paper, a computer or a graphing calculator. 5. Express numbers and <u>variable expressions</u> using exponents. 6. Recognize a variety of uses for variables; e.g. placeholder for an unknown quantity in an equation, generalization for a pattern, formula. 7. Recognize and combine like <u>algebraic terms</u>. 8. Justify that two forms of an algebraic expression are equivalent, and recognize when an expression is simplified; e.g., *4m = m + m + m + m* or *a x 5 + 4 = 5a + 4* 9. <u>Evaluate</u> <u>expressions</u> by replacing variables with given values, and use formulas in problem-solving situations. 10. Translate word phrases into <u>algebraic expressions</u>. 11. Use order of operations with regard to <u>algebraic logic</u>.	1. Generalize patterns and sequences by describing how to find the *nth* term. 2. Represent, analyze, and generalize a variety of patterns and functions with tables, graphs, words, and symbolic rules. 3. Identify, formulate, identify, and graph functions with graph paper, a computer or a graphing calculator. 4. Identify functions as <u>linear</u> or <u>nonlinear</u> based on information given in a table, graph or equation. 5. <u>Evaluate</u> <u>algebraic expressions</u> when given replacement values. 6. Translate word phrases into algebraic expressions and simplify them. 7. Use <u>symbolic algebra</u> (algebraic expressions, equations and inequalities), graphs and tables to represent situations and solve problems. 8. Use order of operations with regard to arithmetic and algebraic logic to simplify algebraic expressions and to solve equations and inequalities. 9. Extend the uses of variables to include <u>covariants</u> where *y* depends on *x*. 10. Define and use terms <u>monomial</u>, <u>binomial</u>, <u>trinomial</u>, <u>polynomial</u>, <u>term</u>, <u>variable</u>, <u>exponent</u>, <u>factor</u>, and <u>coefficient</u>. 11. Use physical models to add and subtract monomials and polynomials, and to multiply a polynomial by a monomial.	

12. Create visual representations of equation-solving processes that model the use of <u>inverse</u> <u>operations</u>.

13. Solve <u>one-step linear equations and inequalities</u> involving +, -, x and ÷.

14. Graph linear equations and inequalities on a number line or a coordinate plane.

15. Use computers or graphing calculators to analyze change; e.g., distance-time relationships.

12. Use a calculator to extend the concepts of inverse operations.

13. Solve multiple step linear equations and inequalities involving +, -, x and ÷, graphically, symbolically and using a graphing calculator.

14. Solve <u>2 by 2 systems</u> of linear equations graphically and by simple substitution.

15. Interpret the meaning of the solution of a 2 by 2 system of equations; e.g., point, line, no solution.

16. Solve simple <u>quadratic equations</u> graphically; e.g., $y = x^2 - 16$

17. Compute and interpret <u>slope</u>, <u>midpoint</u> and <u>distance</u> given a set of ordered pairs.

18. Plot points in the <u>Cartesian plane</u> and determine the slope of the line they form.

19. Describe the relationship between the graph of a line and its equation, including being able to explain the meaning of slope as a constant rate of change and *y*-intercept in real-world problems.

20. Analyze change in various contents such as <u>linear</u> vs. <u>nonlinear</u>, <u>continuous</u> vs. <u>non-continuous</u>.

21. Use graphing calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

22. Add, subtract, multiply and divide monomials, polynomials (division of polynomials by monomials only).

23. Simplify rational expressions by eliminating common factors and applying properties of integer exponents.

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Patterns, Functions and Algebra – Standard E
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Patterns, Functions and Algebra – Standard E
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Data Analysis and Probability Standard

Students pose questions and collect, organize, represent, interpret and analyze data to answer those questions. Students develop and evaluate inferences, predictions and arguments that are based on data.

Grade 7 Indicators	Grade 8 Indicators	
1. Read, interpret, and construct picture, bar, line, circle and coordinate (all four quadrants) graphs, tables and histograms. Include double bar and double line graphs. 2. Read, interpret and construct box-and-whisker plots, and stem-and-leaf plots. 3. Analyze how decisions about graphing affect the graphical representation; e.g., scale, size of classes in a histogram, number of categories in a circle graph. 4. Find the mean, median, mode, and range and determine which measure of central tendency is most appropriate. 5. Analyze a set of data by using and comparing measures of central tendency (mean, median and mode) and measures of spread (range, quartile, interquartile range), and describe how the inclusion or exclusion of outliers affects those measures. 6. Compare data from two or more samples to determine how sample selection can influence results. 7. Identify misuses of statistical data in articles, advertisements, and other media. 8. Collect data to design a statistical experiment to study a problem. 9. Construct convincing arguments based on analysis of data and interpretation of graphs. 10. Explain the difference between single events and compound events and find the probability of single events or compound events occurring.	1. Read, interpret, and construct picture, bar, line, circle and coordinate (all four quadrants) graphs, tables and histograms. Include double bar and double line graphs. 2. Read, interpret and construct box-and-whisker plots, stem-and-leaf plots and scatterplots. 3. Make conjectures about possible relationships in a scatterplot and approximate line of best fit. 4. Read, develop, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, make predictions, and explore effect of changing scale. 5. Evaluate different graphical representations of the same data to determine which one is the most appropriate representation for an identified purpose; e.g., line graph for change over time, circle graph for part to whole comparison, scatterplot for relationship between two variants. 6. Find the mean, median, mode, and range and determine which measure of central tendency is most appropriate. 7. Explain the mean's sensitivity to extremes and its use in comparison with the median and mode. 8. Compare two sets of data using measures of central tendency (mean, mode, median) and measures of spread (range, quartiles, interquartile range, percentiles). 9. Use conjectures to formulate new questions, plan new studies, and detect misuses of statistical or numerical information.	

Grade 7 Indicators	Grade 8 Indicators	
11. Make predictions, test the predictions and compare the <u>actual results</u> to the <u>predicted results</u>. 12. Identify <u>permutations</u> and <u>combinations</u> and the relationships between them. 13. Perform calculations and simplify <u>factorials</u> expressions; e.g., 4! = 4x3x2x1 = 24. 14. Explain and define the <u>fundamental counting principle</u>. 15. Determine the number of possible permutations and/or combinations for a situation using the fundamental counting principle.	10. Collect data to design a statistical experiment to study a problem. 11. Identify different ways of selecting samples, such as <u>survey response</u>, <u>random sample</u>, <u>representative sample</u> and <u>convenience sample</u>. 12. Describe how the relative size of a sample compared to the target population affects the validity of predictions. 13. Differentiate between <u>discrete</u> and <u>continuous data</u> and appropriate ways to represent each. 14. Find the probability of <u>single events</u> or <u>compound events</u> occurring. 15. Explain the difference between <u>independent</u> and <u>dependent events</u>. 16. Demonstrate an understanding that the probability of either of two <u>disjoint events</u> occurring can be found by adding the probabilities; e.g., "What is the probability of drawing a heart or a diamond from a deck of cards?", and that the probability of one independent or dependent event following another can be found by multiplying the probabilities; e.g., "What is the probability of drawing a heart then a diamond from a deck of cards. 17. Perform calculations and simplify <u>factorial expressions</u>; e.g., 8!/6! = 8x7=56 18. Identify <u>permutations</u>, <u>combinations</u>, the <u>counting principle</u> and the relationships among them. 19. Use formulas to calculate combinations and permutations 20. Calculate the number of possible outcomes for a situation, recognizing and accounting for when items may occur more than once or when order is important.	