# CCSS Math Practices - <http://www.corestandards.org/math/practice>

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in mathematics education.

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| 1. **Make sense of problems and persevere in solving them** | This practice overarches *all* problem solving. Students must be able to interpret for themselves **what the question is asking** and discern what information is **relevant** and what is superfluous. They must also develop the desire and technique to start *any* problem and the stamina to adjust course and keep going when they encounter obstacles. |
| 1. **Reason abstractly and quantitatively** | This practice asks students to think about all the **symbols** they use. Students need to be able to pull the symbols (numbers or variables or expressions) out of the problem’s context; manipulate, calculate, combine, etc. these symbols; then interpret the result and take it back into the context of the problem. |
| 1. **Construct viable arguments and critique the reasoning of others** | Students must use **reasoning** and **logic** skills to piece together **arguments** to support their claims. They must also be able to **evaluate** the reasoning of others to identify faults in logic or evidence that might refute others’ arguments. These skills will serve students in a number of realms of life. |
| 1. **Model with mathematics** | This practice is about **using** **math** to **represent** a **situation** and being able to explain how the parameters of that situation are **reflected in the model**. This practice could include establishing a line of best fit in the midst of a scatterplot; creating a quadratic equation that represents the path of a projectile; developing a system of equations or inequalities that allows for comparison of two proposals; writing a number sentence that represents a story. |
| 1. **Use appropriate tools strategically** | Tools include everything from brain power (mental math) to pencil and paper, to physical tools (rulers, protractors, compasses) to calculators and other “technology” (recognizing that pencils and paper were once very advanced technology). Tools could also be graphic organizers, charts, tables, graphs, manipulatives, etc. |
| 1. **Attend to precision** | This practice is much more about precision in language and communication than it is about accurate calculations. It is about sharing ideas using the most (developmentally appropriate) concise language and descriptions available. |
| 1. **Look for and make use of structure** | Structure in this case means how the number or expression or equation is built or composed. Whenever we decompose a number to make calculations easier or more sensical, we are using its structure. Any time we identify a component of an equation as the vertex of the graph or the slope of the line, we are making use of the equation’s structure. |
| 1. **Look for and express regularity in repeated reasoning** | Many big, complex problems can be solved by starting with smaller, simpler problems and recognizing the patterns inherent in those smaller problems. Students should also build a sense for when a result is unexpected—re-evaluating and looking for errors rather than blindly accepting whatever the calculator says. |

# High School CCSS Math Standards – Summary of those applicable to CTE

The high school standards call on students to practice applying mathematical ways of thinking to real world issues and challenges; they prepare students to think and reason mathematically. They set a rigorous definition of college and career readiness, by helping students develop a depth of understanding and ability to apply mathematics to novel situations, as college students and employees regularly do. The high school standards emphasize mathematical modeling, the use of mathematics and statistics to analyze empirical situations, understand them better, and improve decisions. “Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. It is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social and everyday situations can be modeled using mathematical and statistical methods.”

Grade 7

* Use ratios and proportional relationships to solve real-world problems; perform operations with fractions.
* Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
* Solve problems involving angle measure, area, surface area, and volume.
* Compare and draw inferences about populations using statistics and probability models.

Grade 8

* Use radicals (square roots) and integer exponents.
* Use functions to model relationships between quantities; relate proportional relationships with linear equations.
* Analyze and solve linear equations and systems of equations.
* Apply the Pythagorean Theorem; solve problems involving volume of cylinders, cones, and spheres.

High School: Number and Quantity

* Use the real number system (rational and irrational numbers with exponents) to reason quantitatively with units to solve problems.
* Perform operations on vectors, matrices, and with complex numbers.

High School: Algebra & Functions

* Write functions/equations that describe relationships and situations.
* Perform operations on linear, quadratic, exponential, and polynomial functions.
* Represent and solve equations, inequalities, and systems of equations (algebraically and graphically) to solve problems.
* Interpret the structure and meaning of mathematical expressions; explain the reasoning used to solve equations in the problem-solving process.
* Interpret functions (equations) that arise in applications in terms of the context.
* Analyze functions in different representations.

High School: Geometry

* Make geometry constructions and experiment with transformations in the plane.
* Use trigonometric ratios and solve problems involving right triangles and angles.
* Apply arc lengths and areas of circles; explain volume formulas and use them to solve problems.

High School: Statistics & Probability

* Summarize, represent, and interpret data and interpret linear models.
* Make inferences and justify conclusions from surveys, experiments, and observational studies.
* Use probability models to determine likelihood of events and evaluate outcomes of decisions.

# Next-Generation Science & Engineering Practices - <http://www.nextgenscience.org/next-generation-science-standards>

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| 1. **Asking questions and defining problems** | Students should be able to ask questions of each other about the texts they read, the features of the phenomena they observe, and the conclusions they draw from their models or scientific investigations. For engineering, they should ask questions to define the problem to be solved and to elicit ideas that lead to the constraints and specifications for its solution. |
| 1. **Developing and using models** | Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Students should be able to evaluate the merits and limitations of two different models of the same system. Students should understand and experience models being revised and tested to make predictions and solve problems. |
| 1. **Planning and carrying out investigations** | Scientific investigations may be undertaken to describe a phenomenon, or to test a theory or model for how the world works. Students should be able to design investigations and select appropriate tools to collect, record, analyze, and evaluate data. |
| 1. **Analyzing and interpreting data** | Students should be able to present data in a form that reveals patterns and communicates those patterns with others. They can then make decisions based on statistical or experimental evidence. |
| 1. **Using mathematics and computational thinking** | Students are expected to use mathematics to represent physical variables and their relationships, and to make quantitative predictions. Computers and digital tools can enhance the power of mathematics by automating calculations or approximating solutions to problems that cannot be calculated precisely. Students must apply ratios, rates, percentages, and unit conversions in the context of complicated problems. |
| 1. **Constructing explanations and designing solutions** | Students should apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. Design, evaluate, and/or refine a solution to a complex real-world problem, based on research, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| 1. **Engaging in argument from evidence** | Students should argue for the explanations they construct, defend their interpretations of the associated data, and advocate for the designs they propose. Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. |
| 1. **Obtaining, evaluating, and communicating information** | Students need to develop their ability to read and produce domain-specific text. As such, every lesson is in part a language lesson, particularly reading and producing the genres of texts that are intrinsic to science and engineering. Students must also communicate scientific and/or technical information or ideas in multiple formats (i.e., orally, graphically, textually, and mathematically). |

# Performance Task Resources

Sample tasks in architecture, agribusiness, food, and health sciences: <http://achieve.org/ccss-cte-classroom-tasks>

NYC Searchable Task Database: <http://schools.nyc.gov/Academics/CommonCoreLibrary/TasksUnitsStudentWork/default.htm>

Inside Mathematics: <http://www.insidemathematics.org/index.php/mathematical-content-standards>

MARS Tasks: <http://map.mathshell.org/materials/index.php>

# Project-Based Learning Resources

PBL-Online.org: <http://www.bie.org/tools/freebies>

# Task/Project Design Worksheet

Task/Project Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Subject/Content Area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Task/Project Driving Question: |
| What are the instructional objectives of this activity?  CTE: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Math: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Aligned CCSS Math Standards & Practices: |
| How will you assess the objectives? How can you be sure students have mastered them? |
| What activities will students undertake to meet the objectives? What deliverables will they need to submit along the way?  Major Deliverable:  Anticipated Class Time Required: \_\_\_\_\_\_\_\_\_\_\_ class periods |
| How will you engage students as you introduce the activity? |
| Review your PBL Elements Checklist. Does your project…  ○ Focus on Significant Content ○ Develop 21st Century Skills  ○ Engage Students in In-Depth Inquiry ○ Organize Tasks Around a Driving Question  ○ Establish a Need to Know ○ Encourage Voice and Choice  ○ Incorporate Revision and Reflection ○ Include a Public Audience |