



DSA
 Alternate Base Systems
 for Cross-Curricular Fun & Engineering Applications

CONCORDANCE WITH STANDARDS

Teachers can incorporate "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications" into their curriculum PreK-12th Grade and thereby meet a variety of national STEM (Science, Technology, Engineering, and Math) standards including but not limited to:

1. [ITEEA's Technological Literacy Standards; National Science Education Standards; Principles and Standards for School Mathematics,](#)
2. National Research Council's [Framework from K-12 Science Education](#)
3. The [Common Core Math Standards.](#)

Below are the exact standards within each of the three online documents which are met via thorough use of "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications". We sincerely hope that this unit on alternate-bases will be interesting and useful to teachers and students in diverse classrooms around the United States.

1. Teachers who utilize "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications" will meet the following national standards: [ITEEA's Technological Literacy Standards; National Science Education Standards; Principles and Standards for School Mathematics.](#)

Nature of Technology 3: "Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study."

--- Choice of base is often taken for granted, however base has a huge impact on the ease of design in a variety of fields (time, calendars, measurement of length, trades, construction, and engineering).

Technology and Society 4, 6, 7: "Students will develop an understanding of the cultural, social, economic, and political effects of technology." (4) "Students will develop an understanding of the role of society in the development and use of technology." (6) "Students will develop an understanding of the influence of technology on history." (7)

--- Over time different cultures have utilized different bases for different purposes. By learning about different bases in the context of bases as cultural tools utilized for specific purposes, students will obtain a deeper understanding of the impact of technology on society.

Design 9: "Students will develop an understanding of engineering design"

--- *Through creating their own numbers to signify dec and el in the dozenal base, and then picking the best in their group, students will learn and apply principles of engineering design as well as collaborate with others in their group to "design" the most effective symbols and justify their design.*

Abilities for a Technological World 11, 13: "Students will develop abilities to apply the design process." (11) "Students will develop abilities to assess the impact of products and systems." (13)

--- *Via the individual reflective, analytic, and creative activities followed by the synthetic evaluative, collaborative group work students will participate in engineering design and iterative assessment at a variety of levels from individual to small group to whole class. The fact that no broadly accepted symbols for dec and el in the dozenal base have emerged adds additional challenge and excitement, because if students are able to design universally pleasing symbols, their work has the potential to be used globally!*

The Designed World 17: "Students will develop an understanding of and be able to select and use information and communication technologies."

--- *Indeed in terms of Standards 17, students will be doing more than just "selecting and using" "information and communication tools"; students have the potential to **design** such tools themselves!*

2. In addition, because the Next Generation Science Standards will not be complete before these proposals are due, we are relying upon the National Research Council's [Framework from K-12 Science Education](#). The following specific engineering standards are met via use of the "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications" unit.

Practice 1: Asking questions and defining problems (science & engineering)
 Practice 4: Analyzing and Interpreting Data (science & engineering)
 Practice 5: Using Math and Computational Thinking (science & engineering)
 Practice 7: Engaging in Argument from Evidence (science & engineering)
 Practice 8: Obtaining, Evaluating, and Communicating Information (S&E)

Core Idea ETS (Engineering, Technology, Science)1A,B,C:
 Engineering Design A, B, and C (Defining, developing, optimizing)
 Core Idea ETS2A,B: Interdependence of ETS & Influence of ETS on Society/Nat. World

3. Also, the following [Common Core Math Standards](#) are met via use of the "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications" unit. Direct Link: http://www.p12.nysed.gov/ciai/common_core_standards/pdfdocs/nysp12eclsmath.pdf retrieved on 1/24/13

PreK-12th Grade: Mathematical Practices

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

PreK, K: Counting and Cardinality (CC), Operations and Algebraic Thinking (OA),
Measurement and Data (MD), Geometry (G)

K, 1, and 2: CC (Count to 20, Count to 100, count within 1,000), OA (addition and subtraction with place value, addition and subtraction up to 100, multiplication readiness), Numbers and Operations in Base-10 (NBT) (place value 1's, 10's, 100's, 1000's and operations), MD (work with length, time, and money)

Grade 3 & 4: OA3 (multiply and divide within 100), NBT3 & NBT4, MD3&4 (measure and estimate intervals of time, linear measurement, liquid volumes, masses of objects)

Grade 5-7: OA5 (analyze patterns and relationships), NBT5 (place value, apply operations to multi-digit whole numbers and decimals to the hundredths), MD5 (convert like measurement units within a given measurement system), Expressions and Equations (EE6) (dependent and independent variables), Statistics and Probability (SP7) (draw inferences about one and two populations based on random sampling, develop, use, and evaluate probability models)

Grade 8: Functions (F8) (Define, evaluate, and compare functions and Use functions to model relationships between quantities)

High School: Mathematical Practices

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