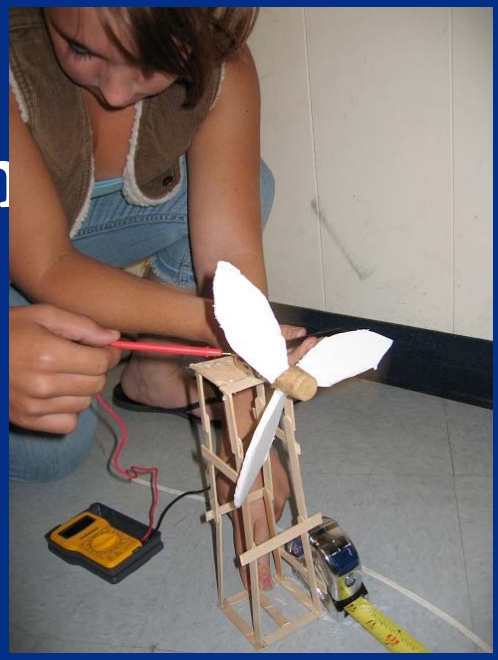
ConnectEd
The California Center for College and Career

Transforming today's education
for tomorrow's economy

Building Pre-Algebra Skills Through Project-Based Learn



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Agenda

- The role of ConnectEd
- Why create project-based pre-algebra curriculum?
- What does the curriculum look and feel like?
- Implementation considerations
- Questions and comments

Organizing Principles for Linked Learning

- Pathways prepare students for postsecondary education and career—both objectives, not just one or the other.
- Pathways connect academics to real-world applications by integrating challenging academics with a demanding technical curriculum.
- Pathways lead to a full range of postsecondary and career opportunities by eliminating tracking and keeping all options open after high school.
- Improve student achievement

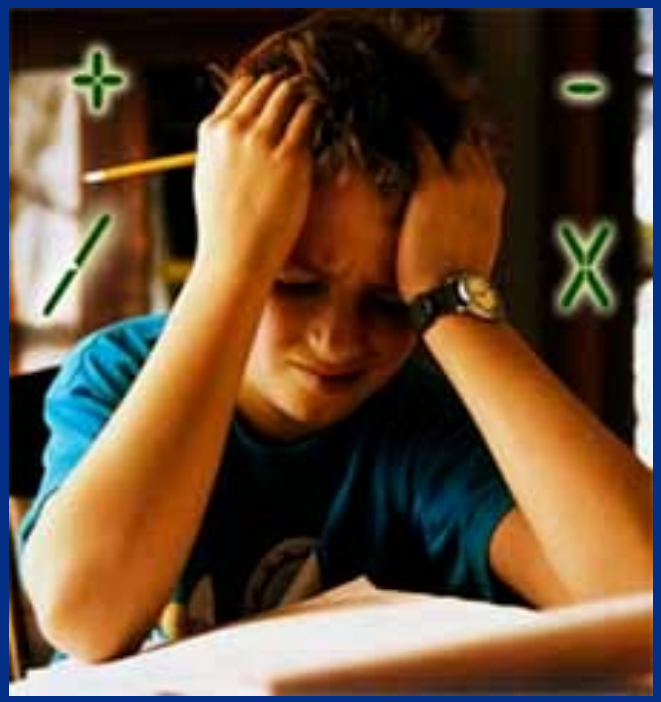
Core Components of a Pathway

A multi-grade program consisting of:

- A challenging ***academic core*** meeting postsecondary admissions requirements of UC, CSU, and community colleges
- A demanding ***technical core*** meeting industry standards
- ***Work-based learning*** experiences that complement classroom instruction
- ***Support services*** including supplementary instruction, counseling, and transportation

Why Project-Based Pre-algebra?

- Many avoid post-secondary science and engineering programs because of their math requirements.
- A survey of math and CTE teachers showed that students lack pre-algebra skills. This leads to difficulty in all subsequent math, science, and technical courses.



Why Project-Based Pre-Algebra?

- Math concepts and skills students struggle with:
  - Number sense and fundamental arithmetic (fractions, percents, decimals, estimation of reasonable answers)
  - Basic problem solving skills
  - Using geometry tools: ruler, protractor, compass
  - Basic math vocabulary
  - Proportional reasoning, Slope, and Scale
  - Concept of Area
  - Solving simple equations
  - Using formulas correctly in context

Why Project-Based Pre-Algebra?

- Projects create a *need to know* and motivation to learn math. They add relevance, authentic problem solving, and 21st century skills to math content.

- Hands-on, contextualized activities show students that math can be enjoyable, useful, and important. This increases achievement and retention.

What Does Project-Based Math Look Like?

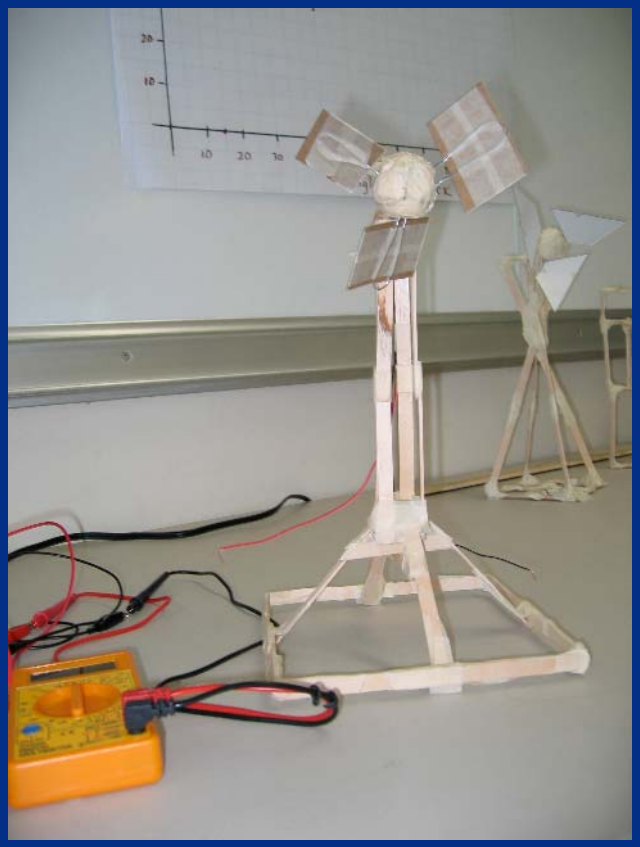
Access Ramp Activity

- Find a partner.
- You need a ruler, pencil, and the handouts.
- Complete the assignment with your partner. As you work, list the math concepts you needed to be successful.

Access Ramp: Math Concepts

- Measurement
- Fractions
- Proportional Reasoning: scale drawings
- Proportional Reasoning: slope, linear growth
- Problem solving strategies

Unit 1: Wind Power



What are efficient wind turbine designs?

Unit 1: Wind Power

Skills and Concepts:

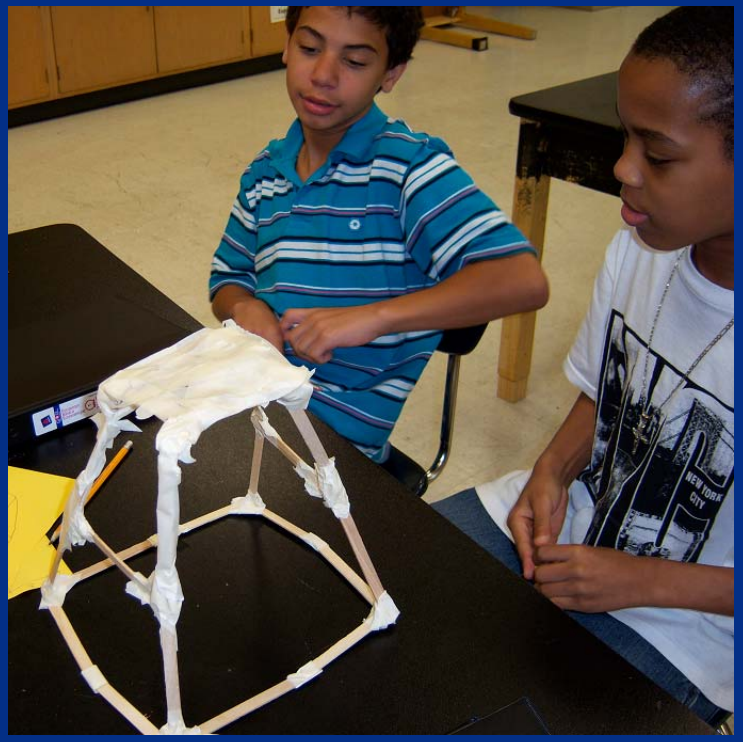
- Measurement – Length, Area, and Angles
- Equivalent Fractions
- +/-/×/÷ Fractions
- Calculate percentages
- Express constraints and range of results as inequalities and compound inequalities

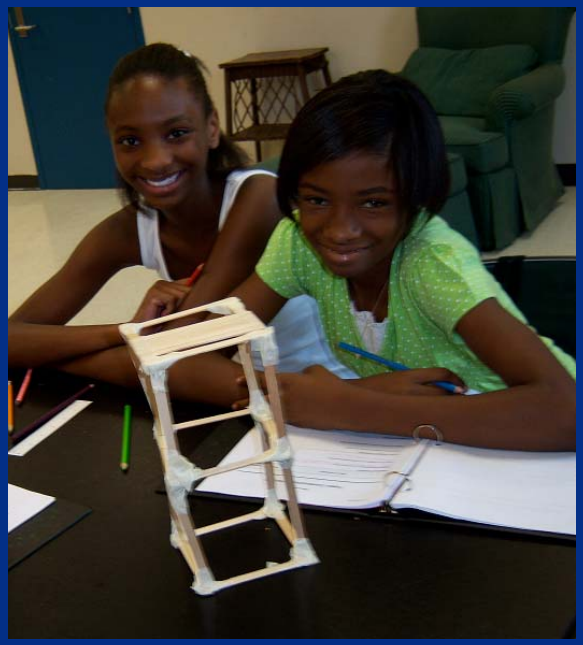
•Graph and interpret experimental results

•Build a working wind turbine to meet certain constraints that optimizes results

•Present wind turbine design to class and justify design choices

Unit 1: Wind Power





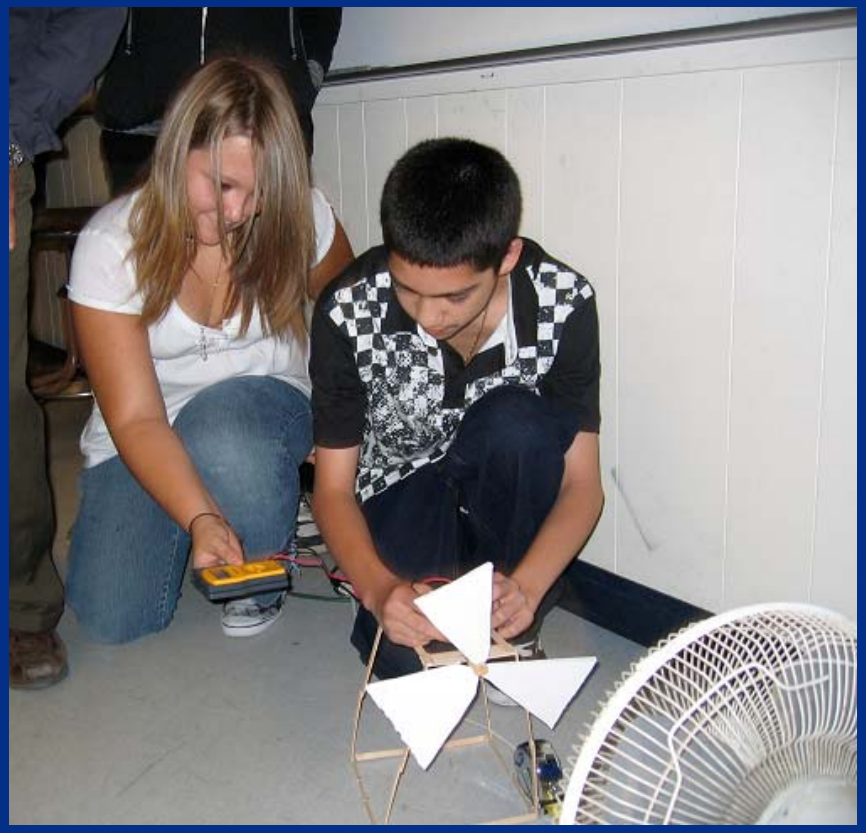
Practice addition and subtraction of fractions by building a tower for the wind turbine.

Unit 1: Wind Power

Practice fraction multiplication by building rotor blades of a given area.

Calculate percentages when analyzing quantity of scrap materials.

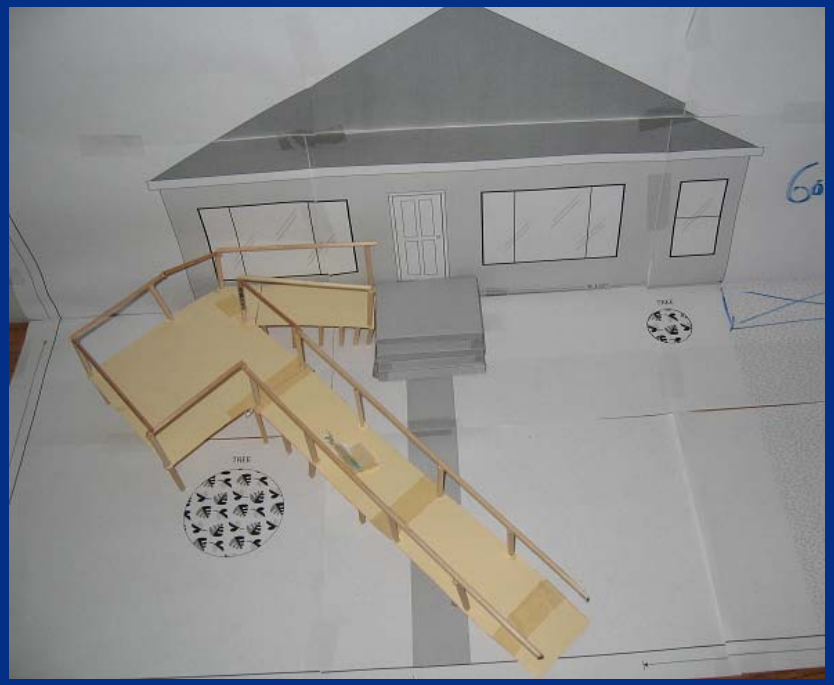
Unit 1: Wind Power

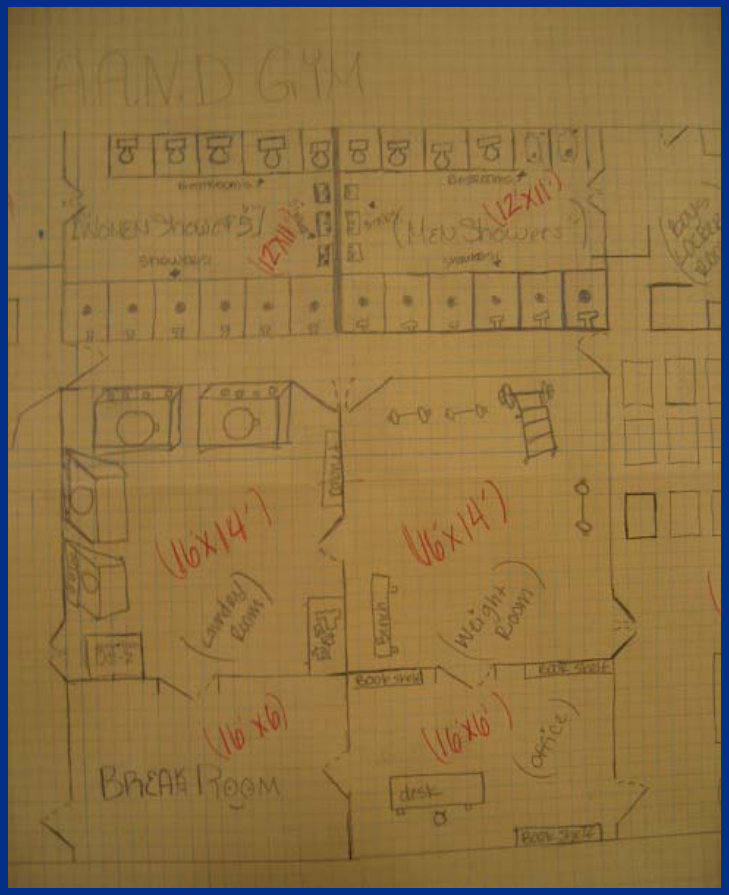


Test designs and record results as inequalities.

Interpret graphs of results and present findings.

Unit 2: Blueprints and Models





How do you design a construction project?

Unit 2: Blueprints and Models

Skills and Concepts:

- Measurement – Length and Area
- Mapping space to scale
- Solving problems involving proportions and ratios
- Understanding slope as it relates to linear growth
- Calculating and converting fractions, percents, and decimals
- Performing unit conversions
- Creating pie charts
- Calculating percent of increase or decrease
- Designing and constructing a model of a building to fulfill specific constraints and preferences

Unit 2: Blueprints and Models

Review proportions, scale, and slope by building a model wheelchair ramp that meets ADA guidelines.

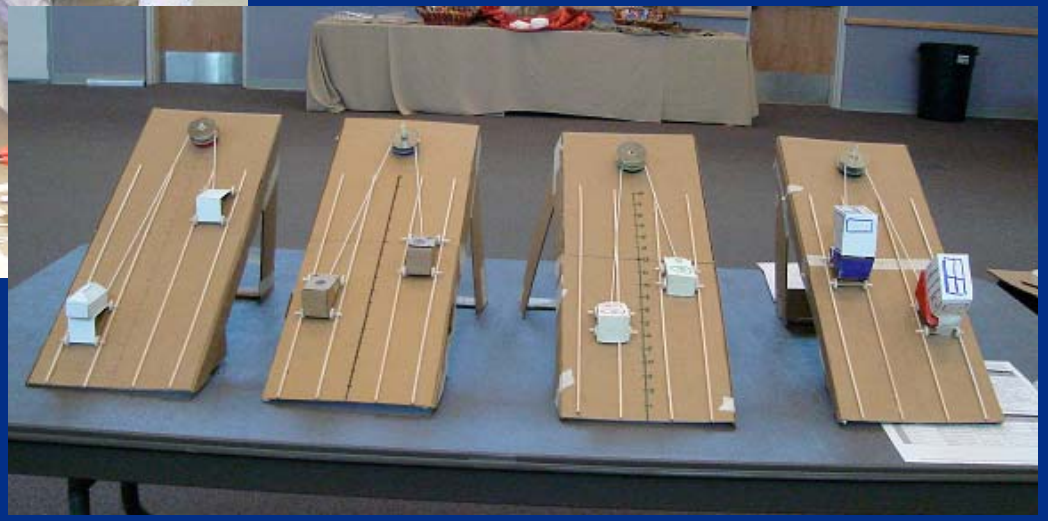
Practice unit conversions by creating a materials list and cost chart.

Unit 2: Blueprints and Models

- Calculate and interpret the space allocation of buildings.
- Create pie charts to present findings.
- Practice solving construction-related problems involving ratios and proportional reasoning.
- Design a remodeling plan under space and structural constraints, including a cost estimate.

Unit 3: People Movers

How do you engineer an effective funicular system?



Unit 3: People Movers

Skills and Concepts:

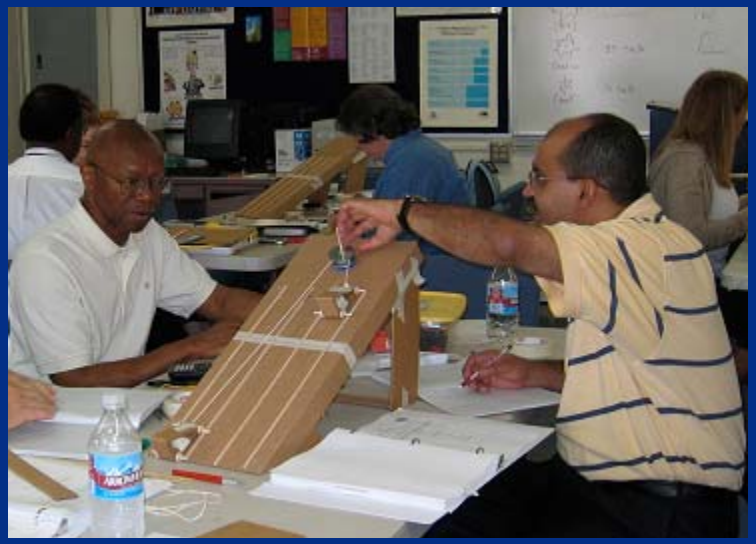
- Solving problems involving proportions and ratios, including gear ratios
- Interpreting the meaning of linear and non-linear graphs
- Understanding the slope of distance vs. time and velocity vs. time graphs
- Arithmetic with negative numbers
- Understanding and solving problems using the Pythagorean Theorem
- Simplifying square roots

Unit 3: People Movers

Use the Pythagorean theorem to construct a ramp for the funicular.

Apply the concept of similarity and parallel line relationships to build a platform for the funicular car to ride on.

Unit 3: People Movers



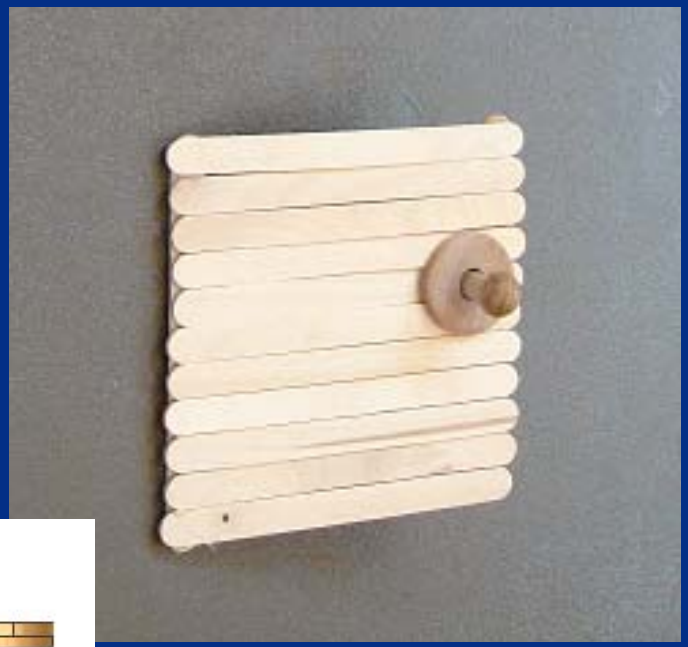
Use integer operations to calculate and describe position and velocity.

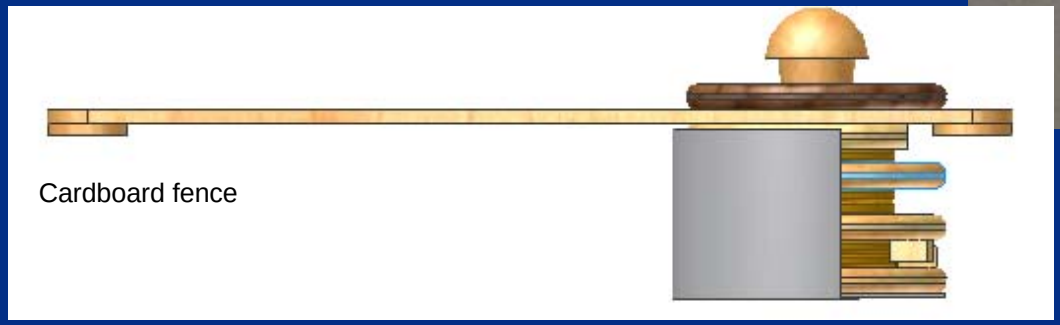
Determine the travel time by applying knowledge of gear ratios.

Graph and interpret linear and non-linear results.

Unit 4: Safe Combinations

How safe is a combination lock?





Unit 4: Safe Combinations

Skills and Concepts:

- Tree diagrams and permutations
- Definition of exponents, graphing exponential growth
- Rules of exponents
- Order of operations
- Inverse operations
- Equivalent equations and solving 1–5 step equations
- Translating sentences into algebraic equations
- Building and analyzing a working safe with a combination lock to specifications

Unit 4: Safe Combinations

- Calculate the total possible number of combinations for a lock.
- Use the rules of exponents to analyze changes to the number of lock combinations.
- Practice solving equations by "coding" and "decoding" lock combinations.

Practical Considerations

- Initial Cost: $200 - $500
- Consumable Materials: $10-$25 per unit
- Many materials can be borrowed from the school science department.
- None of the units require power tools, lab space, or special engineering knowledge.
- Approximately 70 hours of instruction
  - Example: 6 week summer school, ~2.5 hours/day

Other ConnectEd Curriculum

Algebra I Project-Based Units

- Can be used as either supplemental or replacement material during the year
- Expands and reinforces the engineering theme and practice of problem solving skills in math class
- Covers major Algebra I standards (linear and quadratic equations, rational expressions, exponents, polynomials)

Engineering Integrated Units

Biomedical and Health Sciences Integrated Units

Thank You For Participating!

Please contact us for more information about curriculum materials and professional development:

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http://www.ConnectEdCalifornia.org

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