

Lesson Focus: Structural Engineering/Bridge Design

Time: 50 min.

Lesson Plan

Subjects: Algebra/Geometry/Physical Science (8th-12th grades)

Presenter: Dr. Charles Camp - See Speaker Bureau for contact information.

Guiding Question, Course/Grade Level Expectations, and SPI's are included for 6th, 7th, and 8th grade Math and Science, Physical Science, Biology, Physics, Algebra 1, Algebra 2, and Geometry. (**See the Standards Tab.**)

Materials (per group/pair):

K'NEX, (4 red beams, orange beams, 4 long gray beams, 4 white connectors, and, 4 yellow connectors).

Computer with mouse (Preloaded with West Point Bridge Designer 2004 Software.)

Preparing the lesson:

1. Preload student computers with West Point Bridge Designer 2004 Software (v 7.0.6).

Teaching the Lesson:

CHALLENGE #1

With the Knex materials supplied, build the tallest free-standing structure.

4 red beams, 4 orange beams, 4 long gray beams, 4 white connectors, and, 4 yellow connectors

Compare various student designs. Possibly, allow students to repeat to try to improve.

Discussion: Structural Engineering PowerPoint – What is structural engineering? How does structural Engineering relate to Bridge Design? Introduction to West Point Simulation software, including step-by-step instructions for using the software and posing simple challenges for students to learn software tools.

CHALLENGE #2

Build a truss bridge, created by individual members in tension or compression. Use West Point Bridge Designer 2004 (v 7.0.6)(free download) to create and simulate bridge, while considering cost.

In software, **Red** elements represent Compression, **Blue** elements represent Tension

Compression – before it fails, it will buckle $C = (\pi^2 EI) / L^2$ E=Material property(constant), I= Moment of Inertia, L=length

$T = F/A$ Tension=force/Area

If failing, increase area.

Engineering is an **iterative** process!! Try again, and again, and again....

CHALLENGE #3

Build a truss bridge with an arch. Use West Point Bridge Designer 2004 (v 7.0.6)(free download) to create and simulate bridge, while attempting to lower cost.

Assessment: Award points to teams for successful designs with the lowest costs.

1st place - 10 points, 2nd place – 8 points, 3rd place – 6 points, all other successful bridges – 4 points

Closing Activity: Journal writing- Have students reflect on their method(s) of problem solving and communicating. What could they have done differently to improve accuracy and efficiency?

Extension: Experiment with original designs, versus designs from templates. Submit bridge design(s) to West Point website for competition.

<https://www.bridgecontest.org>