

## Grade 4 Design Challenge Quick Guide: Design a Bridge to Withstand Forces– Cycle 1

**Lesson Objective(s):** The students will apply concepts of pushes and pulls to the design of a model bridge.

### Materials:

*For each team of 2 or 3 students*

- Design logs
  - Rope
  - Scales
  - Foam Pieces (12” long x ~2.5” wide, 2 per group (1 for constructing prototype , 1 for redesign)
  - Dowels, 12” long 3/16” diameter
  - String 16” long
  - Two piece dowel ~1.5” long to apply the tension to the string
  - Bucket and small cup
  - Large amount of sand
  - Rulers, pencils, scissors
  - Lego plates from Lego kits
  - 2 parallel planes ( e.g., equally thick books, lying flat with 2 inches of overlap on each side)
  - Various building materials (teacher discretion) for student bridge designs, if desired (e.g., additional string, scissors, cardboard, etc.)
  - Handouts
    - “Bridges Y-Chart”
    - “Bridges Report”
    - 21<sup>st</sup> Century Skills rubric to grade the project
- Websites
    - <http://science.howstuffworks.com/engineering/civil/bridge7.htm>
    - <http://www.pbs.org/wgbh/nova/tech/build-bridge-p4.html>
    - [http://www.google.com/search?q=bridges&safe=active&es\\_sm=93&source=lnms&tbn=isch&sa=X&ei=aACBU6PQJo2zsASj\\_YHoCA&ved=0CAgQ\\_AUoAQ&biw=1746&bih=890](http://www.google.com/search?q=bridges&safe=active&es_sm=93&source=lnms&tbn=isch&sa=X&ei=aACBU6PQJo2zsASj_YHoCA&ved=0CAgQ_AUoAQ&biw=1746&bih=890)
    - <https://www.brainpop.com/technology/scienceandindustry/bridges/>

### TEKS:

#### *Science*

\*SCI.4.6D Design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.

PS SCI.4.2B Collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps.

#### *Math*

PS MATH 4.1A Apply mathematics to problems arising in everyday life, society, and the workplace.

R MATH 4.11A Estimate and use measurement tools to determine length (including perimeter), area, capacity, and weight/mass using standard units SI (metric) and customary. (Pre-Teach, Cycle 3 )

ELPS	CCRS Science	CCRS Math	CCRS Cross-Disciplinary
C3D, C5B	5E1A, 8C2A	3A2F, 8C1C	1C1B, 1E2C

**Engineering Design Loop:** *For more details, refer to the overview page.*

**Identify the Need:** Teams of 2-3 students will be challenged to design a bridge deck.

**Research the Problem** Teams will conduct research on bridges using kid-friendly websites.

**Develop Possible Solutions:** Teams will use their researched information to create 2 bridge deck designs.

**Select the Most Promising Solution:** Teams will decide and select which of the 2 designs to make into their final bridge deck.

**Construct a Prototype:** Teams will build their bridge deck with their materials and according to their established procedures.

**Test & Evaluate:** Teams will test their bridge decks at the testing area to learn about forces.

**Communicate their Design:** Teams will share their bridge data, compare designs, and learn about what works from a discussion with other teams.

**Redesign:** Teams will redesign their bridges to withstand tensile forces (pulling).

**Math Connection:** Students will use an algorithm to calculate the stress of a sample bridge and then be challenged to calculate the stress of their bridge design in alignment with appropriate, grade level math standards.