Materials Science Lesson

Goal: Practical Use of Engineering Design Process in Relation to Materials Evaluation and Manufacturing (Evaluating Materials for Structural Stability)

NGSS Standards:

MS-ETS1-1  
MS-ETS1-2  
MS-ETS1-3  
MS-ETS1-4

MS-ESS3-2

Objective:

1. Students will be able to identify materials that are strong/weak in compression, tension, and torsion.
2. Students will be able to use materials to design and build a free-standing structure.
3. Students will be able to keep a budget on cost of materials to build a free-standing structure.
4. Students will be able to test a free-standing structure for earthquake resilience.

Materials:

1. Various building materials such as: balsa wood, toothpicks, and craft sticks.
2. Adhesive (hot glue, tape)
3. Earthquake shake table (if you do not have, make out of two pie plates with marbles between)

Activity:

1. Students will test each building material for strength when put under compression, tension, and torsion.
   1. Compression (build 10-15 cm truss model out of each material). Put model standing tall on the table. Stack books onto model to breaking point. Observe the number of books and any observations.
   2. Tension: place model lengthwise halfway on the table. Attach a spring scale to the end and pull until breaking point. Observe and record the amount of force used to break and any other observations.
   3. Torsion: place model lengthwise halfway on the table. Twist model until breaking point. Measure final angel before breaking and record along with any other observations.
2. Observe each material for hardness, flexibility, and any other observable properties.
3. Using all results of testing and observations design a blueprint of initial model adhering to constraints and criteria.
   1. Criteria of Tower: 30-35 cm height, 5 width, 5-10 cm length. Must be free-standing (not attached to base)
   2. Constraints: Materials, glue/tape is only adhesive not a building material, each material has a cost and budget is $5,000.
4. Build Model based on blueprint (changes can be made from original design but must be noted on the blueprint)
5. Testing: Test model on earthquake shake table for stability and resilience.
6. Quantifying Variable to test model would be time on shake table before breaking. This can be a discussion with students and have them develop a testable variable.
7. Can define “breaking point” in class discussion.