**Impact of Materials on Society**

**Module 7 - Concrete Research Experiment (Day 1)**

**Group #: \_\_\_ Group Names:**

**Pre-Class Assignments:** Optional reading for those interested in following an anthropological perspective on materials this week: [The Materials of Life](http://www.mrs.org/ingold-in-the-making-chapter-2/) (PDF), from Tim Ingold (2013) *In the Making: Anthropology, Archaeology, Art and Architecture.* Chapter 2: The Materials of Life. London: Routledge

**Activity Objective:** How does Concrete composition affect its tensile strength?

Question:

What is the optimum ratio of cement to sand to gravel to make the strongest concrete in tension (unreinforced)?

Background:

The optimum ratio according to the experts is 1 part cement to 2 parts sand to 3 parts gravel if the concrete is used in compression. Our goal is to try to determine if the ratio is the same when the concrete is used in tension.

Approach:

As a class we will make bars of concrete with different compositions. We will then break these bars using an impact testing approach and measure the energy absorbed by each bar during fracture. Each group will submit their findings and then as a class we will take the results of all the groups and plot a 3-D graph of how composition affects the tensile strength.

**Making Concrete Activity**

Each group will receive sand, cement, and gravel and a small bucket, gloves and a paint stirring stick. Each group of 4-5 students will make 2 bars.

1. The first bar uses just these three ingredients and you can provide each group with a different ratio of the ingredients if you want to conduct an experiment to determine what ratio is the strongest or allow them to decide the ratio.
2. For the second bar, allow them to reinforce the bar with whatever they want to bring to class (pencils, paper, fabric, wood, whatever)

Make the bars on a Monday and allow them to cure until Friday.

Possible variations of concrete for each group to make.

|  |  |  |  |
| --- | --- | --- | --- |
| Group # | Cement | Sand | Gravel |
| 1 | 1 | 2 | 3 |
| 2 | 1 | 0 | 5 |
| 3 | 1 | 0.5 | 4.5 |
| 4 | 1 | 1 | 4 |
| 5 | 1 | 1.5 | 3.5 |
| 6 | 1 | 2 | 3 |
| 7 | 1 | 2.5 | 2.5 |
| 8 | 1 | 3 | 2 |
| 9 | 1 | 3.5 | 1.5 |
| 10 | 1 | 4 | 1 |
| 11 | 1 | 4.5 | 0.5 |
| 12 | 1 | 5 | 0 |
| 13 | 1.5 | 0.5 | 4 |
| 14 | 1.5 | 1 | 3.5 |
| 15 | 1.5 | 1.5 | 3 |
| 16 | 1.5 | 2 | 2.5 |
| 17 | 1.5 | 2.5 | 2 |
| 18 | 1.5 | 3 | 1.5 |
| 19 | 1.5 | 3.5 | 1 |
| 20 | 1.5 | 4 | 0.5 |
| 21 | 2 | 1 | 3 |
| 22 | 2 | 1.5 | 2.5 |
| 23 | 2.5 | 1 | 2.5 |
| 24 | 2.5 | 1.5 | 2 |
| 25 | 3 | 1 | 2 |
| 26 | 3 | 1.5 | 1.5 |
| 27 | 3.5 | 1 | 1.5 |
| 28 | 3.5 | 1.5 | 1 |
| 29 | 4 | 1 | 1 |
| 30 | 4.5 | 0.5 | 1 |
| 31 | 4.5 | 1 | 0.5 |
| 32 | 5 | 0.5 | 0.5 |
| 33 | 5.5 | 0 | 0.5 |
| 34 | 5.5 | 0.5 | 0 |
| 35 | 6 | 0 | 0 |