Name _____ **Date** _____ **Class** _____

Making Concrete Blocks

Materials needed:

For each group

- 3 pairs of gloves
- 3 Rubbermaid or Sterilite ice cube bins, available at Target for $3.99 each
- 3 to 4 paint sticks, 98¢ for a 10-pack at Home Depot (or you can get them for free from most stores that sell paint if you say it is for a class project)
- a small bucket (3 gallons or less) available at Amazon or a local hardware store
- 3 dust masks available in packs of 50 at Amazon
- 3 dust masks

For the entire class to share

- Recycled, reused, or discarded items; students may bring these in from home (the materials should ideally fall under one of three categories: metals, ceramics, polymers, or composites)
- 10-12 pairs of scissors
- 1-2 hammers
- lab scale or lab balance
- plastic wrap and masking or painters' tape to protect the balances—optional, but highly recommended
- large tarps (along with painters tape) to protect the lab area— optional, but recommended; 6 x 8 foot blue, multipurpose, waterproof Grizzly Tarps work well and are available on Amazon
- 2 bags of Sakrete: 94-lb Portland Cement Type I/II Commercial Grade Quickrete, available at hardware stores like Lowe's or The Home Depot
- buckets for cement
- cups for scooping out and weighing cement—8 oz. Styrofoam cups work well
- 6-8 gallons of water (tap water is okay)
- 1 premade sample to serve as example (optional)

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Today you play the role of a materials engineer. You will combine different materials to accomplish the goal of enhancing building materials used in shantytown construction.

Day 1: Warm-up Questions and Group Plan

1. What is your engineering design challenge?

2. What is a composite?

3. What are the four categories of materials as defined in materials science?

4. What are the ideal physical and chemical properties that you want concrete to have?

5. What materials are readily available that could be used as-is or repurposed?

Meet with your group members, and plan what will be used as the material composite for your concrete block. Record your plan below. Each person will make their own piece but you will analyze the data for all three. Each person will add one type of material to their cement.

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Day 2: Block Construction

Materials:

- plastic ice cube bin
  ruler/tape measure
- Portland cement (five to six 8 oz. cups of cement)
- water
- materials that will make up your concrete composite

Procedure

1) Measure the height of your ice cube bin. Use tape to make a mark all the way around your bin to ensure that your sample will be the correct size.

2) Record what you put into your mixture in exact measurements. You might be adding more or less cement to your overall mixture depending on the size and volume of your materials.

3) Mix cement and the water; each block will probably need between five to six 8 oz. cups of cement, or more depending on the size of your bin and the volume of your materials. It should turn into a runny toothpaste consistency. When you have achieved that consistency, start adding your chosen materials. You might need to add more cement and water, because you will need to make sure that the plastic tub is almost full of your mixture.

    a. Consider the orientation of your materials when mixing them with the cement. You may want to consider placing your materials horizontally, vertically, etc, so they provide optimal support.

4) After you have mixed your test pieces together, write your name on a piece of tape and attach it to the tub. Take it to a designated area inside the classroom so the test pieces can dry over the next two days.

Sample 1

Material Added (cement, water, etc.)	Mass or Volume (if a liquid)

SUBSTANCE	TOTAL MASS

TOTAL MASS OF BRICK:

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Percentage Composition Calculation:

To find the percentages of the composition of your test block, you will need to find the total mass of your entire test piece. For example: 350 g of cement + 300 g of water + 15 g of Styrofoam= 665g

To find the percent of your block that is each component, you divide the mass of the component by the total mass and multiply this by 100 to get a percentage.

(350 g cement/665 g total)*100=52.6% cement

This percentage is important if you need scale the piece up. For example: if you needed to make 100,000 g of your cement piece, you would need to use 52,600g of cement.

100,000 g total * 0.526 of cement = 52,600 g of cement

Find the percent composition of your sample.

Material	Percent Composition

Find the total masses of one of your partner's components and calculate the percent composition.

SUBSTANCE	TOTAL MASS

Material	Percent Composition

Find the total masses of your other partner's components and calculate the percent composition.

SUBSTANCE	TOTAL MASS

Material	Percent Composition