FEBRUARY 15

LEARNING ACTIVITY:

Aggregates Matter

Grades 6-9

Materials

- Portland cement (a specially manufactured product made from a mix of limestone, clay, and other ingredients)
- Sand (fine aggregate)
- Pea-sized gravel (coarse aggregate)
- 3 paper cups (all same size)
- 3 strong paper plates with curved sides
- 1 tablespoon-size scoop
- Plastic spoons
- Water
- Heavy, flat object like a 2- to 3-lb rock
- Safety glasses, laboratory protective gloves, and closed-toed shoes

Note: Handle the Portland cement with caution, avoiding contact with skin and eyes and following all instructions on label.

Crushed stone, sand, and gravel are the three kinds of rock fragments that are called aggregates. Consider: At the current rate of usage, every American will need 1.37 million pounds of aggregates in his or her lifetime. Aggregates are mined in every state in the nation. Aggregates are the most commonly used mined rocks in all countries of the world.

One of the most common uses for aggregates is to make concrete. A typical mixture (by volume) is about 10-15% cement, 60-75% aggregates and 15-20% water. Concrete is needed for the construction of buildings, bridges, roads, and sidewalks. Look around your home or school. What do you see that's made of concrete? What do you think would happen if the concrete used for buildings, bridges, and roads were not made strong enough?

A concrete mixture cures (hardens) because a chemical reaction occurs among the mixed substances, not because the water "evaporates." During this reaction, called hydration, crystals radiate outwards from the cement grains and mesh with other adjacent crystals or adhere to the adjacent pieces of aggregates. The pieces of aggregates give the concrete strength. Concrete is denser and stronger if particles of varied sizes are used. The larger particles provide a sturdy "skeleton," and the smaller particles fill in holes.

Procedure

1. Using Table 1, scoop the number of tablespoons indicated into the paper cups. Label each cup with its sample number. (Wear safety gloves for steps 1-4.)
2. Stir each cup's dry ingredients together so they are evenly distributed.
3. Add water slowly, stirring and keeping everything evenly distributed until the mixture is fully moist and consistent. It will take about 1-2 tablespoons of water for each cup.
4. Smooth the top and let the mixture cure for 48 hours.
5. Tear the cups away from the mixture and place each on a different paper plate with the sample's number.
6. In Table 2, describe each sample and predict what will happen when the samples are tested for strength. Will the amounts of aggregates in the different samples make a difference?
7. Test the strength of each sample by dropping a heavy, flat object on each from a height of two feet. Wear safety glasses and closed-toed shoes.
8. Describe and record the results. Did they match your predictions? What is your conclusion?

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Table 1: Sample Propotions

	Sample 1 (recommended Ratio)	Sample 2	Sample 3
Ingredient	Ratio	Ratio	Ratio
Portland cement	1	1	1
Sand (line aggregate)	2	4	1
Gravel (coarse aggregate)	3	1	4

Table 2: Predictions, Results and Conclusion

	Sample 1	Sample 2	Sample 3
Description of Sample and Predictions			
Description of Sample and Results			
Conclusion			

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