America's Cement Manufacturers™

Portland Cement Association
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Lesson 1: The Uses of Concrete

Age: Grades 7-12
Subjects: Material Science, Earth Science
Skills: Classification, identification, discussion, listing, application, observation
Duration: 45 minutes
Group Size: Any
Setting: Classroom
Key Vocabulary: Cement, concrete

Objectives
Students will learn 1) The difference between cement and concrete; 2) How cement and concrete are used, and 3) How cement is made.

Method
Students will view a video about cement and concrete, then create a list of places where concrete is used.

Background
Cement and concrete might be synonymous as household terms, but by nature are different. Cement, an ultra-fine gray powder, binds sand and rocks into a mass or matrix of concrete. Cement is the key ingredient of concrete.

Semantics aside, concrete is the signature material in driveways, patios, basements, and a host of other household items. It also is the world's most widely used building material. Annual global production of concrete is about 5 billion cubic yards. Yearly cement production levels are about 1.25 billion tons.

Concrete's global appeal is not accidental—some of the world's most abundant resources produce the universal, stone-like material.

Portland cement is a generic term for nearly all modern cement. It owes both name and origin to a British stone mason named Joseph Aspdin. In the 1820s, Aspdin's quest for a manufactured counterpart to natural or Roman cement (derived from volcanic ash and other naturally occurring minerals) led to his discovery and patent of portland cement.

Aspdin's name for his invention served two purposes. It distinguished the material from Roman cement, which existed for centuries. It also was a marketing ploy. Concrete made from his new cement resembled a highly prized building stone quarried on the Isle of Portland.

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Page 2

Modern portland cement is the product of high temperature conversion of finely ground materials—often as basic as blends of limestone, clay, and shale—containing four key ingredients: calcium oxide, silica, alumina, and iron. Producers rely on native materials. Cement plants sit near quarries with rocks bearing some or all of these elements.

When processed in a long horizontal furnace known as a rotary kiln, blends of raw materials reformulate into glass-like nodules called clinker. Suppliers then grind clinker and gypsum to extreme fineness to produce cement. The finished product is shipped to concrete producers in bags or in bulk.

Cement's natural chemistry comes to life in the presence of water, sand, and gravel or crushed stone—known as fine and coarse aggregate. Upon mixing with water, cement's calcium compounds hydrate to form new agents that bind the aggregates into concrete.

Like cement, concrete is produced from local resources, with many grades of fine and coarse aggregate available from region to region to meet standard and special mix needs. Concrete products come in many forms and applications each of which, when properly formulated, handled, and placed, can provided decades of service.

Materials
Copy of Portland Cement Association Video, *A New Stone Age.* pencils and paper.

Procedure
Introduce the project of working with concrete by describing the activities that the students will be doing and which concepts you want them to master. Show the class Portland Cement Association's video *A New Stone Age*. Generate further interest by asking, "Where have you seen concrete being used?" The verbal list of uses should be quite long and should include the uses of concrete that are underground and others not readily seen. This list stresses the importance of concrete in our lives. Display this list in the classroom so that student may add to it.

After making the list as a class, ask the student to make their own written list of uses of concrete. This list should be continually enlarged as the course expands the student's awareness of the applications of concrete as a building material.