

## MAKING GARDEN PAVING STONES

### STANDARDS

See summary of National Science Education Standards.

Original: <http://books.nap.edu/readingroom/books/nses/>

Standard Concept	General Standard	Specific Standard	General Standard	Specific Standard	General Standard	Specific Standard
Grade level		K-4		5-8		9-12
Science as Inquiry (A)	Abilities ... to do ... inquiry	A.1.4.1				
		A.1.4.5				
	Understandings about ... inquiry	A.2.4.2				
Physical Science (B)	Properties of ... materials	B.1.4.1	... changes in properties of matter	B.1.8.1		
		B.1.4.2		B.1.8.2		
		B.1.4.3				
Earth and Space Science (D)	Properties of Earth Materials	D.1.4.1				
Science and Technology (E)	Understanding about ... technology	E.2.4.2				
	Distinguishing between natural and human-made objects	E.3.4.1				
		E.4.3.2				



Science ... and Social Perspectives (F)	Types of resources	F.3.4.1	Populations, resources, and environments	F.2.8.2	Natural Resources	F.3.12.1
		F.3.4.2				F.3.12.2
		F.3.4.3				
	... technology and local challenges	F.5.4.2	... technology in society	F.5.8.3		



## MAKING GARDEN PAVING stones

### INTRODUCTION

Concrete plays a very important part in our everyday lives. It is used almost everywhere; streets, sidewalks, foundations for homes and schools and most buildings. Driveways, runways, freeways, skyscrapers and playgrounds, all are examples of where we use concrete. In some areas of the country homes are being made and decorated with concrete and winning awards. Concrete is durable, affordable, and .... Concrete!

What is concrete? The “ingredients” in concrete all occur in nature. Sand and aggregate are minerals and/or rocks which require extraction (mining) and processing in order to be combined into the finished product – concrete. Cement, which acts as the ‘glue’ that ‘cements’ the sand and gravel together, comes from limestone and is mixed with other minerals mixed to specific proportions. These types of minerals are termed “industrial” minerals.

Definitions:

- 1) Concrete
  - a) The hardened product formed by the chemical reaction of water and cement when added to a mixture of natural mineral aggregate.
- 2) Cement
  - a) An inorganic substance that is made by combining various proportions of limestone, clay, iron ore and gypsum, then ground and calcined (heated to drive off the water and carbon dioxide). When water is added the cement forms the ‘glue’ which holds the concrete together.
- 3) Aggregates
  - a) Gravel or crushed stone
- 4) Sand
  - a) A rock or mineral having a diameter of 0.05 – 2 mm

### OBJECTIVE

Students will investigate the use of mixtures of earth materials to make useful materials. Older students are encouraged to consider the constraints on the use of concrete in society.

### MATERIALS

- Sand
- Aggregate (gravel)
- Cement
- Water
- Pans and spoons and spatulas for mixing
- 6 oz paper cups for measuring
- Container or mold for paving stone
- Paint stirrers
- Decorative materials.



## PROCEDURE

- 1) Into a medium size pan or tub, mix 4 cups (24 oz total volume) of sand with 4 cups of aggregate.
  - a) Use the paint stirrer or large spoon to mix.
- 2) Add 1½ cups (9 oz total volume) of cement and mix thoroughly, using the large spoon.
- 3) Slowly add 1 cup (6 oz) of water, mixing continuously.
  - a) Depending on the weather, dampness of the sand and/or aggregate, more or less water may be needed. Be careful not to add too much water.
- 4) Keep mixing.
  - a) The concrete should look like a thick cake batter when ready and should gel when patted.
- 5) Pour the concrete into the mold, filling in all corners and fill to the top.
  - a) It will settle.
  - b) With a flat object, such as a paint stirrer, gently tap across the top of your mold to free up excess water and give the surface a smooth texture. This process is called screeding and the tool used to flatten the concrete is called a screed.
- 6) To decorate:
  - a) NOTE: If you want to decorate the mold prior to pouring the concrete, do so before starting the mix, and set your design in the bottom of your mold.
  - b) Decorate the mold, being careful not to press your decorations in too far.
- 7) Place a dampened paper towel gently over the top of your mold to “cure” the concrete.
- 8) Let mold dry for 24 hours.
- 9) Remove paper towel, turn over your mold, and let your beautiful paving stone fall away ready for placement in your garden.

## EVALUATION

- Investigate various recipes for the concrete, qualitatively. What happens if you add more sand, aggregate, cement, or water (change only one at a time)? How can you test your results quantitatively? What can be measured? How can you measure the strength of the concrete?
- Where are the materials used in making the paving stones found locally? This step may require some research. On the internet, the state geological survey may be of help, or geologic maps, or contacting a local construction or concrete company. The important feature of concrete is that all of the materials are Earth materials, some (or all) of which are available locally.
- What are local restrictions to obtaining the materials locally? Some political considerations (nearness to residential areas, for example) restrict companies from obtaining materials locally even when they are available. This research might require contacting a company that produces concrete.
- What other constraints might there be to obtaining the materials needed for concrete?
- What constraints might there be for the uses of concrete? Consider the properties of concrete.



## TEACHER TIPS

- For younger students, the objective may be merely to get the students to understand that Earth materials are used to make materials used in everyday lives.
- For older students, some research needs to be added, as in the Evaluation section. Get ideas from the students.

