Building With Slabs

Slabs should be shaped when they are fairly soft. Building with them should be done when the slabs have had time to set and are fairly firm.

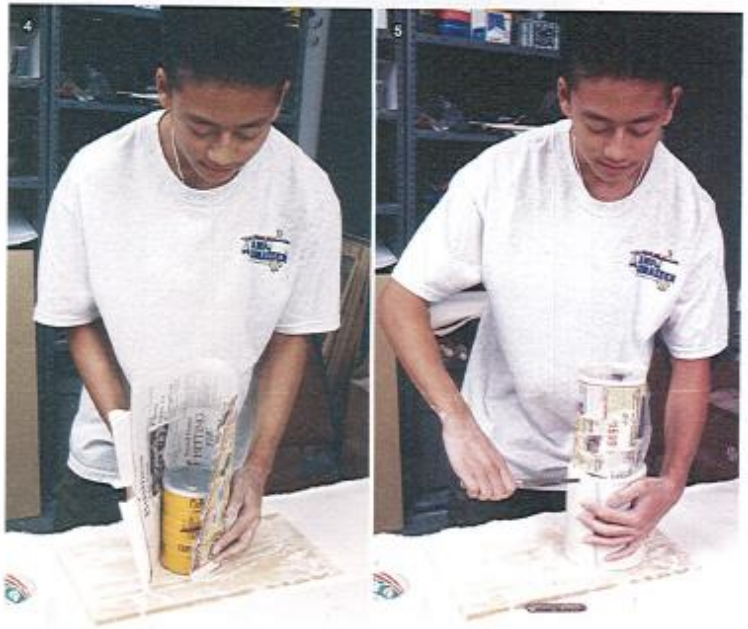
Building a Cylindrical Pot. Slabs can be used to make a cylindrical pot.

Step 1—Think about the shape and size you want your pot to be. Draw a picture of your idea, but don't let that limit your creativity.

Step 2—Use a cylindrical form like a coffee can, soft drink can, or cardboard tube as a support for the pot. Measure the circumference with a tape measure or piece of string.

Step 3—Make a slab several inches longer than the circumference of the form. The width of the slab will be approximately the height of your finished pot. Trim rough edges off all four sides of the slab and reserve this excess for the bottom of the pot. Make sure the edge that will be at the bottom of your pot is trimmed straight with a ruler.

Step 4—While the slab is resting and firming up a little, cover the support form with newspaper, neatly folded and taped with masking tape. The tape should be applied to the newspaper only, not to the support form itself. This newspaper layer will keep the clay from sticking to the form.



Step 5—Wrap the slab around the form. At the overlap, cut through both layers of clay at a 45-degree angle so that you have two mitered edges that will fit perfectly together. Reserve the excess length of clay for the bottom. Slip and score the mitered edges, and press them together to form a smooth seam. Tap the form on the table to make sure the slab is resting at the bottom of the form. The pot can rest like this for a few minutes.

Step 6—If none of the reserved pieces is large enough to use for the bottom, knead them together and roll out a new slab. Set the cylindrical form on the bottom slab and gently trace the outline of the bottom with a needle tool. Remove the cylindrical form; trim the excess clay from the traced outline of the bottom piece. Slip and score the bottom piece and the bottom edge of the pot. Attach the cylinder to the bottom and *carefully* remove the form, leaving just the newspaper layer for support. At this point, the newspaper will be sticking to the clay and the form should pull out easily.

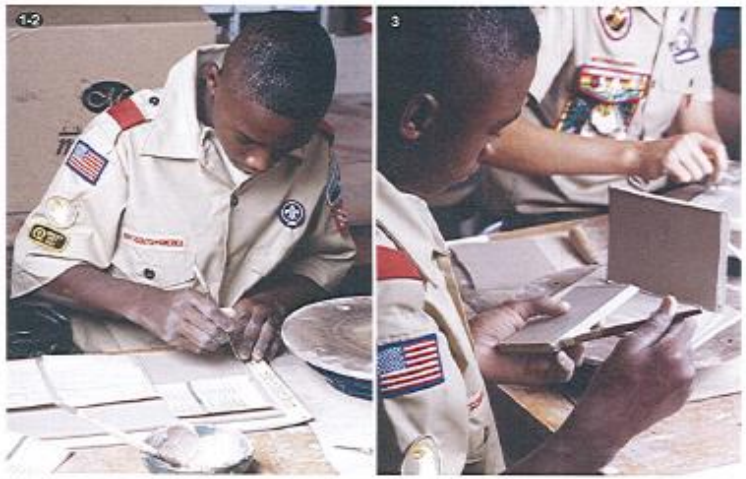
Step 7—Remove the newspaper when the pot is leather hard. Refine the pot if necessary, and carve, **stamp,** or decorate if desired.

In the "slip and score" method for joining pieces of clay, the two surfaces are scratched up and slip is added to create a strong, welded bond. Scoring or texturing the surface makes the clay grip; the added slip acts like glue.

Building a Four-Walled Slab Pot. Using a template will help ensure a uniform shape.

Step 1—Draw a template for each wall and for the bottom of the pot. For a square pot, the walls and bottom will be the same size. For a rectangular pot, two opposite walls will be the same size, and the other two walls will be another size. The bottom can be any size. Cut out the templates.

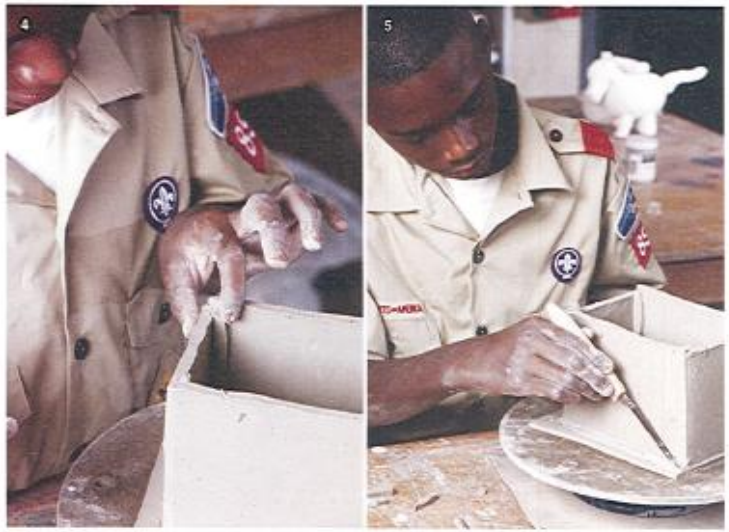
Step 2—Form five slabs, cutting one for each template. Let the slabs rest until they are firm enough that they do not bend when picked up.



Step 3—Attach the walls to each other using one of the following methods:

- Slip and score the edges of two walls, then press them onto a third wall that also has been slipped and scored. The two outside walls are perpendicular to the third wall between them, which is lying flat. Add the fourth wall to the top, then stand the structure and add the bottom.
- Cut the edges of the slabs at 45-degree angles and make mitered corners. Slip and score the edges, then press them firmly together. The structure should be able to stand unsupported.

Step 4—Roll a thin rope of soft clay and press it with your fingers into the joint where two walls come together inside the pot. Repeat for the remaining inside joints.



Step 5—Refine the joints, carve or **clean** the rim, and trim the base to be flush with the outside walls, if desired. Decorate the piece when it is leather hard.

Pinch Pottery

Pinch building was probably the first method used to make a pot from clay. It is almost instinctive when holding a ball of soft clay in your hands to push your thumb into it and then turn it around while pinching the sides, making a hollowed-out shape. Although the method is simple, the result does not have to look primitive or rough.

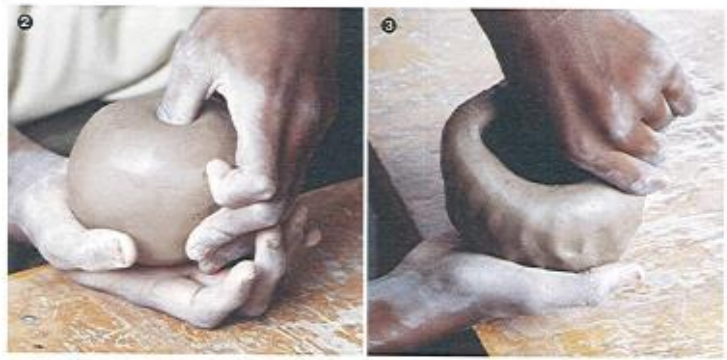
To begin pinch-building, thoroughly wedge and knead the clay. Then make a test pinch. Your finger and thumb should have no clay sticking to them. If any clay sticks, continue the wedging and kneading process.

Continue pinching the clay, turning the clay in one hand and pinching with the other. The warmth of your hands will dry out the pot. This natural drying of the clay as it is worked can help the walls hold their shape as the pot becomes larger, but it also can cause the rim to become crumbly. It is best not to add water to the walls while they are being pinched out; they can become slimy and tear easily if they get too wet.

Making a Pinch Pot. Use the pinch-building technique to create a ceramic pot.

Step 1—Draw a picture of how you want the pot to look and what size you would like to make it. If you have more design ideas during the building process, don't let the picture stop you from using them.

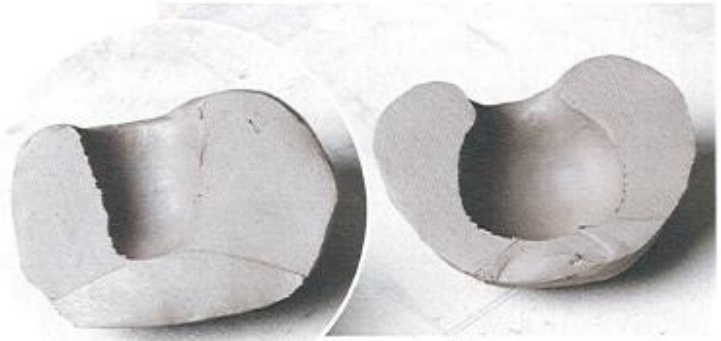
Step 2—Hold a ball of prepared clay in one hand. Using the entire pad of your thumb, gently push the thumb of the other hand into the center of the ball. Slowly rotate the clay and continue pushing the pad of your thumb into the center while rounding out the base of your pot. Work slowly and patiently, using small body movements.



Step 3—With the base established, use a circling series of pinches to raise the walls. Gently pinch the clay between your finger and thumb while turning the pot, making a ring of depressions, each slightly overlapping the ring before. It is important to keep the pressure between your finger and thumb even, and the distance between each squeeze equal.

Step 4—If the pot is to curve inward, gently ease the top inward between each row of pinching. Also, more pressure can be applied from the outside while pinching. If an outward curve is the goal, pinching with more pressure on the inside will cause the pot to expand outward.

Step 5—Variations in the rim—such as bending, curling, or splitting—are part of the pinching process. Sometimes this effect can emphasize the look of the pot, and sometimes a more refined rim is preferred. To refine the rim, cut off the ragged edges with a sharp knife, a needle, or sharp scissors. Then, using a tiny bit of water on your fingers, smooth out the newly cut edge.



Cross-sectional view

Coil Pottery

Coil building is an ancient method of forming pottery. It is still the preferred method for many American Indian potters. Modern potters use this method because coiling allows greater freedom in constructing very large forms and forms that have unusual profiles.

To form coils, first place a small lump of thoroughly wedged and kneaded clay on the table. Place your hands next to each other, with your palms facing down, gently touching the lump of clay. Roll the lump forward and backward in a smooth, even motion.

Rolling coils is not as easy as you might think. If the clay is not soft or bendable, the resulting coil might have a rough, cracked surface and will not be suitable for construction. The coils must be round; making short, choppy movements with your hands will result in a flat-sided coil. The coils must be of an even thickness; coils that are irregular tend to break easily.

Try to relax your hand muscles, and roll the clay at least 10 to 12 inches forward and backward. Some potters roll coils vertically between their palms instead of on a table.

Building With Coils

Coil-built pieces are always built on a slab- or pinch-formed base, which serves as a strong foundation. If the base of a pot were made only of coils, it would very likely crack open and not be structurally sound. When the base is firm, but not leather hard, you can begin adding coils, working in a spiral. Each coil layer must be firmly attached to the layer below it by slipping and scoring. As you work, the bottom layers will start to firm while the top layers are still soft.

Wet coils that are under the pressure of additional layers sometimes sag and fall or collapse, so you might need to pause after adding several layers to allow the wall to become firmer. As you build, weld the coil layers together with your fingers or a tool. This will help prevent cracks from developing in the walls of your pot during firing.

Coil-Building a Cylindrical Pot. Practice the coil-building technique by creating a pot.

Step 1—It is always helpful to design a pot before you begin building it. Draw a picture to help you plan the height and width. Cut a template of the profile if you wish, and use it to check your progress as you work.

Step 2—Ensure that the clay is properly prepared.

Step 3—Form a flat base in the shape of your cylinder. Allow this base to become firm.

Step 4—Slip and score the top edge of the base. Place a coil on this edge, working in a spiral and applying slip to the top edge of each layer.

Step 5—After adding several coils, weld the walls together inside and out. Allow the pot to become firm and strong; this could take several hours. Keep the top layer soft by covering it with plastic. This will allow you to add more coils later.

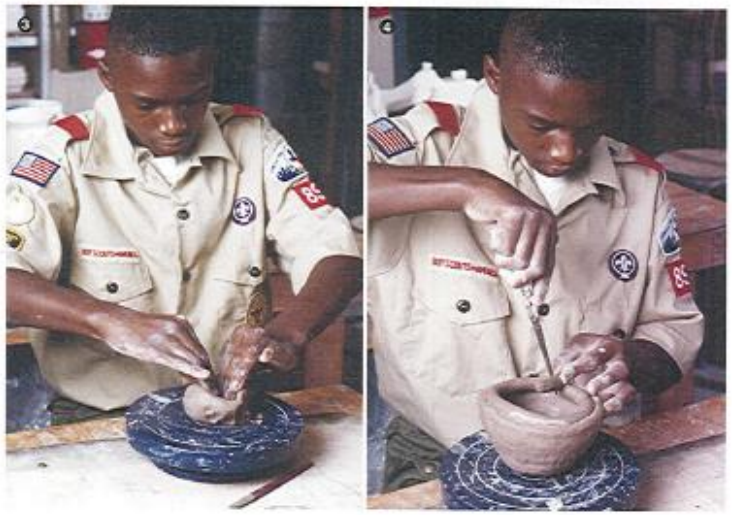
Step 6—When the pot has reached the desired height, smooth the surface if desired. Add a final thick coil to the rim for strength.

Coil-Building a Spherical Pot. The same basic technique can be applied to coil-building a spherical pot.

Step 1—Design your pot. Draw a picture to help you visualize the curve. Cut a template of the profile to help check your progress.

Step 2—Ensure that the clay is properly prepared.

Step 3—Form a rounded base by pinching a shallow bowl with the bottom and sides of uniform thickness. For example, the very bottom of your base might be ½ inch thick and the side would be ½ inch thick and slightly taller than the bottom piece. Some potters put this pinch-bowl base into a wooden or bisque-fired clay dish for support, but the walls of the pinched base must be a little higher than the support dish so that a coil can be added when the base becomes firm.



Step 4—Slip and score the rim of the pinched base and apply a coil to the top outer edge. Continue to apply slip to the rim of the exposed coil, but apply the coil to the top outside edge of it. This will make your pot expand outward in a ball shape.

Step 5—Pause periodically to weld the coils together, inside and out, and then let the walls become firm, leaving the very top edge covered with plastic.

Step 6—Halfway through building, begin to curve inward rather than outward. Now apply each coil to the inside edge of the top coil instead of the outside edge. Continue to build the walls, welding and allowing them to firm, until the pot is complete.

Step 7—Smooth the surface with a rib if necessary.

Ceramic Sculpture

Most ceramic sculptors use common methods for forming sculptures, but the best clay for sculpting might be different from that used for other clay articles. Grog added to a clay body makes the clay more porous and easier to form into irregular shapes.

While you are preparing the clay, think about what kind of sculpture you want to make. Size is one consideration: A small-scale sculpture is generally one that will fit on a table; anything bigger than that is considered large-scale and will require very special treatment to survive the creating, drying, and firing processes.

Making an Animal Sculpture. Follow these instructions to create a ceramic animal sculpture.

Step 1—Draw a rough picture of the animal to help you plan the body parts.

Step 2—Roll out a ball of clay for the body and a smaller one for the head. Score and slip both surfaces to weld the head to the body. Use your fingers to shape the body and head.

Step 3—Roll out coils or cut slab pieces for legs, ears, paws, etc. Attach these parts to the body—from largest to smallest—scoring and slipping the surfaces that will touch; weld them together.

Step 4—Add details, such as eyes, hair, fur, whiskers, etc., using a toothpick, needle tool, paper clip, or other sharp tool.

Step 5—When the piece is complete in the rough, you can smooth it, then add details and decoration. Do not worry about tool marks and fingernail marks that show at this time.

Step 6—Any piece more than ½ inch thick must be hollow so that it will not explode when heated in the kiln. To hollow out a completed sculpture, first wait until the clay is firm enough to stand without support. Carefully cut the sculpture in half. Use a loop tool to hollow out the walls to less than ½ inch thick. Score and slip the walls, and weld the sculpture back together. Use soft clay to repair any seam that shows.

Step 7—Carefully wrap the sculpture in a plastic bag and let it rest for 24 hours, then dry completely and fire.

Thrown Pottery

Making pots on a potter's wheel is known as **throwing.** Throwing pottery on the wheel takes a lot of practice. A skilled potter working at the wheel makes the process look easy, but first-timers nearly always are surprised at how awkward and difficult it can be. Most beginners do not produce an acceptable pot the first few tries. Don't get discouraged; with persistence, you will develop the skill.

The process of throwing a pot can be divided into six steps:

1. Prepare the clay.
2. **Center** the clay into a cylindrical shape.
3. Open the clay.
4. Pull up the walls into a hollow cylinder.
5. Shape the form.
6. Finish the form.

To accomplish these steps, you will need the following:

- An area for wedging and kneading the clay
- A bowl of water near the wheel to keep your hands and the clay wet while throwing
- Tools—sponge, needle tool, wooden knife, cutoff wire, and shaping rib made of wood, metal, plastic, or rubber

Centering the Clay. Because the wheel travels in a circle, pushing the clay into **center** is simply a mechanical process. For a beginner, soft clay is much easier to center than stiff clay. Save stiff clay for slab projects.

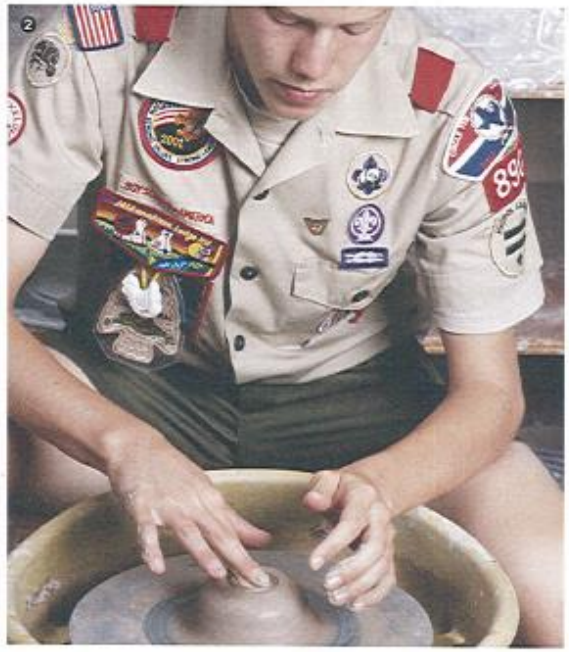
Step 1—Place a prepared ball of clay as close to the center of the wheel head as possible. Give it a little slap to push it down solidly onto the wheel. Dip your hands in the water bowl and turn the wheel to a high speed.

Step 2—Gradually press your hands onto the clay parallel with the wheel head. Then, using your whole body, brace your arms firmly against your hips or legs and stiffen your hands and fingers. Surround the clay on the top and sides with your hands and press toward the center of the wheel with your body weight leaning into it. If your body is braced and stiff, the clay has nowhere to go but into the center. Usually, your left hand controls the side of the clay and your right hand controls the top. Rewet your hands often to keep the clay gliding easily.

Step 3—When the clay feels centered, gradually lighten your pressure on the clay and gently, slowly remove your hands. Any quick moves—either putting your hands onto the clay or taking them off suddenly—will move the clay off center.

Opening the Clay. There are many ways to open a hole in the center of a clay ball. The following is one effective way.

Step 1—With the wheel still spinning at a high speed, wet your left hand and brace the clay around the side. Then place the thumb of your right hand onto your left hand for further bracing.



Step 2—Using a strong finger from your right hand, slowly push that finger into the middle of the clay ball.

Step 3—When your finger gets near the bottom of the clay ball, stiffen your finger and slowly pull your right arm back toward your body. This should open up a hole in the clay.

Step 4—When the hole is large enough, slow down the wheel and, using the pad rather than the tip of your finger, compress the bottom you have just made.

Pulling Up the Walls. Pulling up the walls of a pot is somewhat similar to pinching a wall. The difference is that one hand works on the inside of the pot and the other hand works on the outside, rather than just one hand pinching with the thumb and fingers.

Step 1—Thoroughly wet your hands. Place your fingers at the bottom of the pot, one hand inside and one outside. Your hands will be right next to each other with the wall in between, and your fingertips will do the work. Keep your elbows braced against your hips, your arms stiff, and your hands well-lubricated with water. Press or pinch your hands slightly together, and very slowly, keeping that pinched distance the same, raise your arms to bring your fingers up the wall of the pot.

Step 2—The wall will rise as your fingers distribute the clay upward. As you get to the top, gently release the pressure so that the walls will stay a uniform thickness.

Step 3—As the wheel is going around, support the wall with the thumb and fingers of your outside hand and press down gently on the top rim with the index finger of your other hand. This is called "setting the rim."

Step 4—Repeat this procedure three or four times, or until the pot reaches the desired height and the walls are of the desired thickness.

Shaping the Form. You may notice that pressure from your fingers makes the clay move. If your hands are lined up together, but you press harder with your inside finger than with your outside finger, the wall of the pot will swell outward. Similarly, if you press harder with your outside finger than with your inside finger, the pot will curve inward.

Once the wall of the pot has been moved outward, it is difficult to get it to go back in. However, a narrow pot can easily be made more spherical. Practice using your inside and outside fingers to make gradually curving walls.

Use a sponge to drip water on the walls of the pot to keep them slippery. But be careful; too much water can cause the walls of the pot to collapse. Use just enough to keep the walls well-lubricated.

You also can use a rib to shape the walls. Hold the edge of the rib against a uniformly wet wall. As the wheel goes around, support the wall with one hand and press the rib to move the wall in or out.

Finishing the Form. Use a wooden knife to trim extra clay off the outside bottom of the pot. Then use the cutoff wire to free the pot from the wheel head.

Step 1—Holding the wire at both ends, place it firmly down on the edge of the wheel head that is farthest away from your body.

Step 2—Firmly hold the wire down with your fingers and slowly rotate the wheel, pulling the wire toward your body.

Step 3—When the wire has passed completely under the bottom of the pot, wipe your hands dry. Gently pick up the pot with both hands and place it on a board to dry.

Decorating and Glazing

Many techniques can be used to turn a simple piece of pottery into a uniquely decorated work of art. Experiment with each one to discover how the techniques affect the pottery.

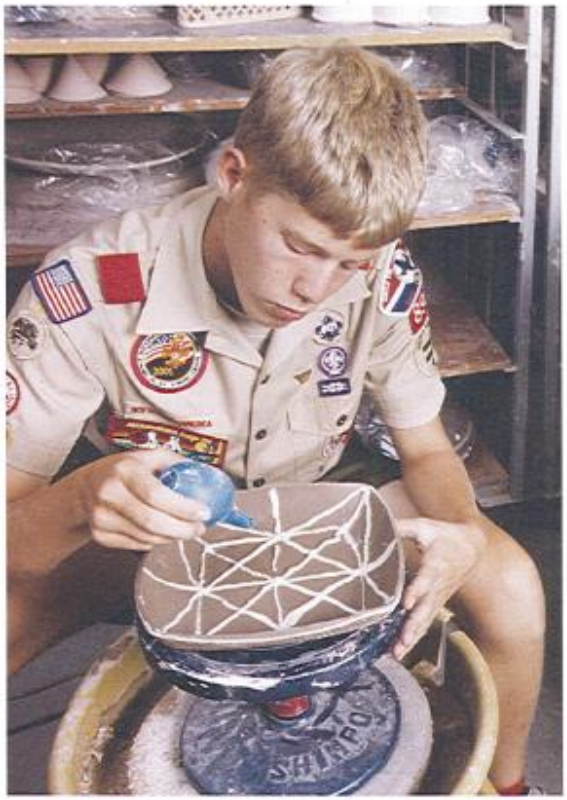
Textured Decoration

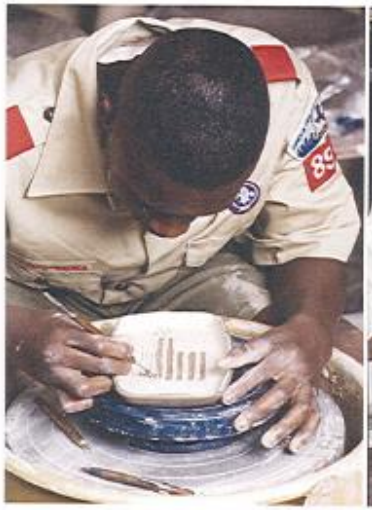
Pottery can be decorated in many ways. Some decorating techniques originally had practical purposes. When primitive potters formed wet pots, their fingers left indentations in the sides. The potters noticed after firing that these dents made the pots easier to handle. Some potters pressed rope into the sides of pots they were forming, making the pots less slippery when wet. As the potters experimented with other objects and tools in their clay work, they noticed that adding these practical features made the pots more interesting to look at, too.

Use your imagination to design pottery projects that will make distinctive textured or indented decorations on the surface.

Decorating With Slip

Another ancient technique that you might consider is slip painting, which simply is painting colored **slip** onto the surface of an unfired pot. Using several fairly thin coats, you can cover the entire pot, or paint a specific design onto it, or you can paint a base coat and then paint a design of a different color on top of that. Once the pot is painted with slip, use a sharp tool to scratch or carve a design through the slip, down to the surface of the clay. This technique is called **sgraffito.**





Slip also can be trailed onto the clay surface of the pot or onto a slip-painted surface for a raised effect. Put some thick slip into an applicator bottle (basically a rubber bulb with a removable nozzle, available from clay suppliers) or any clean squeeze bottle with a narrow, tapered tip (such as a mustard squeeze bottle). While applying constant pressure and working at a constant speed, squeeze out a line of slip in a unique pattern or design.

If several colors of slip trails are placed close together on a pot, the lines can be combed with a feather or a comb from which several teeth have been removed. A marbled effect can be created on the inside of the piece by pouring several colors of slip into a pot and swirling them around slightly. Keep in mind that pots with very thick layers of slip must dry very slowly to prevent cracks.

Most of the time, slips are used on clay that is still wet, and glaze is used on clay that has been bisque-fired. There are exceptions: Some potters glaze their **greenware** and fire it only once, but they must use specially formulated glazes. Some potters apply slip to their **bisque ware,** but again, this slip must be specially formulated.

Applied Decoration

Another attractive way to decorate a clay article is to attach damp pieces of clay in various shapes. This is called sprigging. Sprigs are made by pressing soft clay into a small, decorative plaster mold. The clay hardens quickly and is easily removed with a needle. Paint the edges with a little water, then press the sprig onto the pot.

A Caution About Lead

Lead is a toxic material. If handled improperly in glazes applied to ceramic ware made for drinking or eating, small amounts can leach into a person's system and over time will accumulate to a dangerous level.

The Food and Drug Administration allows the use of lead glazes because of their durability but closely regulates their use with strict controls and guidelines to ensure consumer safety.

For individual potters, using lead in glazes, particularly low-fired glazes such as for raku pottery, can be dangerous to the potter as well as the user of the pottery. Exercise extreme caution when using lead. Check with your merit badge counselor or an experienced potter for guidance on how to safely use lead in glazes.

It is best to play it safe and avoid the use of lead glazes. There are many alternatives available. Using "unleaded" glazes will ensure the safe enjoyment of your piece when it has been fired.

Decorating With Glaze

Glaze is a combination of several substances: alumina, which keeps the glaze from running too much; a flux, which helps the glaze melt into a glass at a safe temperature for the clay; silica to give it shine; and, often, chemicals to add color.

Although much useful and attractive pottery is made without glaze, potters also like to use glaze because it gives functional ware a sanitary, nonporous surface and serves as decoration. To begin experimenting with this type of decoration, first get advice from your merit badge counselor or an experienced potter. Decorating with glaze is a fairly complicated technique, but the sense of accomplishment after a successful glaze firing can be well worth the effort.

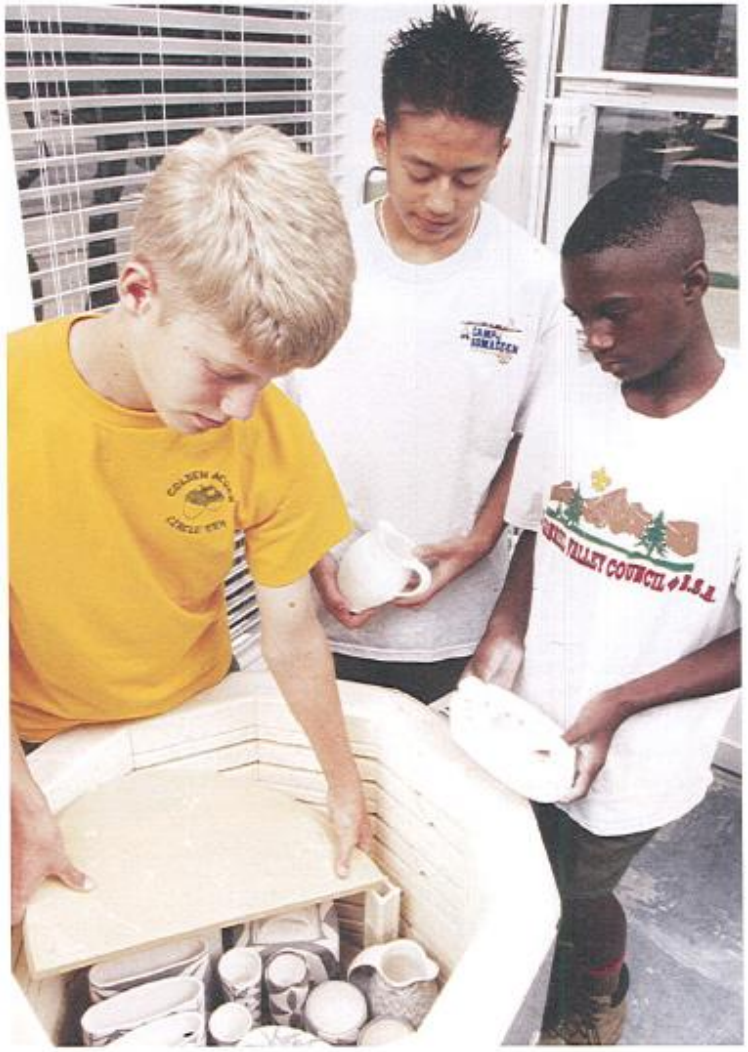
Glaze is nearly always applied to bisque-fired ware. You can use a paintbrush, but it is more effective to dip the pot into the glaze or pour the glaze onto the pot. The inside is glazed first. Pour the glaze into the pot, roll it around to cover the entire inside, and carefully pour it out. After the inside has dried (usually in less than a minute), you can glaze the outside.

Dipping, *above*, is the most effective way to glaze clayware, but pouring the glaze onto the piece, *right*, also is effective.

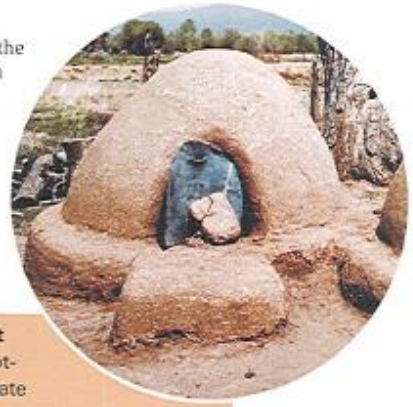
Either dip the piece into the glaze, or hold the pot over the glaze bucket while pouring glaze over the outside. Be sure to wipe the glaze from the **foot** of the piece to keep it from sticking to the kiln shelf when the glaze melts during firing.

Many potters use tongs or gloves when applying glaze to prevent it from getting on their skin. Some chemicals in the glaze can irritate or be absorbed by the skin. If you do get any glaze on you, rinse off immediately with plenty of water.

Commercially prepared glazes, especially those manufactured for low-fire clays, are easily applied with a paintbrush. Follow the instructions on the label. Wash your hands immediately and thoroughly after handling glazes.



Firing



Firing the kiln is undoubtedly one of the most exciting and challenging steps in pottery making. The process can be quite technical. There are several things you will need to know before you begin.

General Rules for Firing

The following safety rules must be followed when firing pottery.

Wear full, sturdy shoes that won't easily melt or catch fire. Open footwear, such as sandals, is inadequate protection for your feet.

All work must be bone dry before bisque firing. This will prevent cracking and possibly exploding. Hold the bottom of the clay article against your cheek. If it feels cold, there is still moisture in it and it is not safe to bisque-fire.

Before loading the kiln, vacuum it out completely. Doing so will prevent bits of kiln dust or brick from landing on your work during firing and spoiling it.

Never brush a kiln shelf with your bare hand. Jagged, razor-sharp pieces of glaze can be stuck to the shelf.

Clayware must be stacked in the kiln skillfully. All pieces should stand level. Unglazed ware can be stacked or packed closely, but glazed ware must stand alone so that melted glaze will not stick or drip onto another piece.

To prevent the piece from sticking to kiln shelves when the glaze melts, **make sure the undersides are not glazed.** If the bottom of a piece is glazed, be sure to use steel-pointed stilts where it would touch the shelf.

Always keep the room in which you are firing well-ventilated. Clay and glazes give off vapors that can be poisonous. Do not stay in the room with a kiln that is firing, even if the room is well-ventilated.

Fire the kiln slowly. An average bisque firing should take no less than eight hours.

Once the kiln has risen to 200 degrees, do not open the kiln door. This would be risky for you as well as the pieces. Do not touch the sides of the kiln or the door handle.

Wear protective insulating gloves and safety glasses or welding goggles when checking the cones through the peephole. Doing so will protect your hands and eyes from the intense heat.

Do not try to open the kiln or remove pieces from the kiln when it is still hot. Wait until everything has cooled enough to handle with bare hands.

Assessing the Heatwork

Before you begin firing, you must know the proper firing temperature for clay (and glaze if you are using it). If you don't fire high enough to mature the clay, the surface will be soft and porous; if you fire too high, the piece will melt out of shape. You also will need to know how to measure the temperature in the kiln to determine whether the proper **heatwork** has been reached.

Before the development of modern aids to measure and control kiln temperatures, potters had to read the heat in a kiln by the color of the flame and the opaqueness of the kiln atmosphere. Today there are various instruments and tools to help potters track the progress inside the kiln.

Pyrometer

There is a special process for measuring kiln temperature. No regular thermometer could withstand the extreme heat in a kiln, but many types of firing require the potter to know the actual temperature in the kiln. A pyrometer, a high-temperature thermometer, is used for this. But the pyrometer alone is not always sufficient for indicating shutoff time. It reads the actual temperature but does not indicate the amount of work done by the heat.

Pyrometric Cones

Pyrometric cones are little pyramids made of clay and glaze that melt and bend, each at its own specific temperature, to signal the end of a firing or, in some electric kilns, to trigger a kiln shutoff. Cones respond to time and heat and are reliable for assessing heatwork. For this reason, many potters use cones in addition to the pyrometer.

Cones are available in a wide range of temperatures. Once you know the temperature at which the clay you are using matures, you would use the cone that corresponds to that temperature, as well as the next lowest and the next highest cones.

Pyrometric cones are numbered in a peculiar way. The lowest temperatures start with a zero; for example, cone 018 corresponds to a common temperature for certain low-fire glazes called **lusters.** Also, the cones are numbered in reverse order, with 018 representing a lower temperature than 015, which represents a lower temperature than 012, and so forth through 01. Then the numbering picks up at 1, and continues in regular numerical order, from the coolest to the hottest temperatures.

For instance, if a potter should say, "This clay matures at cone 06," this means that the firing will be finished and the clay will have become dense and reached its optimum strength when an 06 cone melts in the kiln.

Potters typically do not use cones higher than 15. Earthenware and terra-cotta usually fire to maturity at cone 04. A common high-fire porcelain and stoneware temperature is cone 10. Raku is usually low-fire—cone 06—and salt or soda can create a glaze from cone 7 and up. Wood-burning kilns usually reach very hot temperatures, above cone 10.

Temperature is not the potter's sole concern. A potter needs to know how much work has been accomplished by the heat in combination with how much time has elapsed. This is known as the heatwork.

Cone Pack

To make a cone pack, you will need the cone that corresponds to the maturing temperature of the clay, as well as the next highest and the next lowest cones. For instance, if you will be firing to cone 4, you would use cones 3, 4, and 5.

Line up the cones in a pad of clay. Slant them slightly so that as they melt they will bend over in a direction that will allow you to see them. It works well to slant the lowest cone (which will melt first) away from the other two, and slant those two toward the first one.

When the cone closest to the bottom melts, this is a warning signal. When the middle cone melts—the one that corresponds to the maturing temperature of your clay—it is time to shut off the kiln. This must be done quickly before the third cone begins to melt.

For some larger kilns, it is common practice to place several cone packs in different areas throughout the kiln.

Cones are lined up in the cone pack, all slightly slanting in the same direction.

A cone pack looks like this after it has been used in firing.

Packing the Kiln

When you consider the time and fuel spent in a single firing, you will understand why it is important to pack the kiln efficiently. Not only is it more economic, but it also ensures a more even firing and a good atmosphere in the chamber.

Make full use of the kiln's capacity by grouping similar sizes of ware together. Begin with short or flat pieces on the bottom; save the taller pots for the higher levels. Keep in mind that unglazed ware can be packed so that pieces touch each other; glazed pieces must not touch. Leave ample room for air to circulate around their bases. Keep ware at least 1 inch away from the kiln walls.

Support each shelf with three posts. Some electric kiln shelves require four posts, but an arrangement of three posts usually provides the most stable support, depending on the shape of the shelves. Posts should be at least 1 inch taller than the pots.

Before putting any clayware on the first shelf, place the posts that will support the shelf above. Then, when the first shelf is packed, lower the next shelf carefully into the kiln without touching the side walls or jarring the kiln. Carefully position the shelf and lower it onto the posts. It should be stable enough that it doesn't move when lightly touched.

Position the next set of posts directly over the base posts. It is important for the posts to be stacked directly in line with each other vertically. If posts are stacked vertically offset from each other, the shelves will not be as stable.

Clay articles should be fired in the position in which they will be used when finished. For example, a box, jar, or teapot should be fired with its lid in place. However, clock faces should be fired lying flat to prevent warping.

Make sure cone packs are clearly visible through the **peepholes** in the door or sides of the kiln. Do not place them too close to the peephole or it might be hard to tell which cone is which. If placed too far away among other vague outlines, it might be difficult to tell what is a cone and what is not. Cones are most easily seen against a plain, solid background, whether in front of a large pot or with nothing just behind them.

Average Bisque-Firing Schedule (Cone 06)

Once the work is properly loaded and you have ensured that the cones are easily visible through the peepholes, turn the bottom control on the lowest setting and prop the lid or door slightly open with a soft brick or post; this will allow steam to escape. It is extremely important to ensure that no one—a small child or a pet, for instance—will interfere with the kiln in any way during this preheating phase of the firing.

The kiln can stay in this position for two hours or overnight, if necessary, depending on the thickness of the pots. From this point on, turn up the kiln once every hour as follows:

Hour 1—bottom control on low
Hour 2—middle control on low
Hour 3—top control on low (Close the door or lid before turning the top control on low.)
Hour 4—bottom control on medium
Hour 5—middle control on medium (At this point, if color is visible through the peepholes you can also turn the top control on medium. If the kiln is still dark, wait until hour 6 to turn up the top control.)
Hour 6—top control on medium, or bottom control on high
Hour 7—bottom control on high, or middle and top controls on high
Hour 8—middle and top controls on high if needed

Watch the cones carefully, checking every 30 minutes, until the appropriate cone has melted. Turn off the kiln and let it cool completely.

Firing Schedule for Low-Fire Glaze (Cone 04)

The following is a commonly used schedule for firing low-fire glaze in an electric kiln.

First, preheat by turning the bottom control on low for one hour with the lid or door propped open; this will allow any remaining moisture to escape as steam. Then, turn up the kiln as follows:

Hours 1 and 2—all controls on low
Hours 3 and 4—all controls on medium
Hour 5—all controls on high

The kiln will be ready to shut off within three to five hours after the last controls are turned up. Watch the cones carefully after about two hours.

High-Fire Schedule

Because many high-fire kilns are built by individuals, each kiln follows a unique schedule. Do not attempt to fire any fuel-burning kiln without close supervision from the owner.

Most firings are documented by keeping logbooks. It is possible to follow another potter's log, but commonly the notes about temperature and atmosphere are subjective, and a beginner should never attempt this type of firing unsupervised.

Reduction and Oxidation Firings

Copper oxide can produce a brilliant red in a reduction firing, but it would produce greens in an oxidation firing.

Fuel must have a sufficient amount of oxygen to burn. The dampers in fuel-burning kilns enable the potter to adjust the amount of oxygen inside the kiln. When the kiln contains more than enough oxygen needed to completely burn the amount of fuel being used, the atmosphere inside the kiln is oxidized. However, if the dampers are adjusted so that not enough oxygen is available inside the kiln to burn the fuel, then the air inside the kiln looks smoky and hazy and the atmosphere is reduced.

In a reduction firing, the flame is seeking oxygen inside the kiln, and because there isn't enough, it "steals" oxygen from the clay and glazes. This chemical reaction darkens the clay and changes the look and texture of some glazes. For example, a celadon glaze works only in a reduction firing; it would turn yellowish if fired in an oxidizing atmosphere.

Visit a Kiln Yard

To see firsthand how different kinds of kilns work, visit the kiln yard at a local college or craft school. Many colleges and universities have ceramics programs, often as a part of their art departments or schools of ceramic engineering. Their kiln yards or kiln rooms house various kinds and sizes of kilns.

Work with your counselor to locate and arrange a visit to such a school or facility. You should be able to find one nearby. The National Council on Education for the Ceramic Arts (NCECA) lists about 700 U.S. colleges and universities that offer degrees in ceramics. The list is online at *http://nceca.net/resources/programd.html*. Be sure you have your parent's permission.

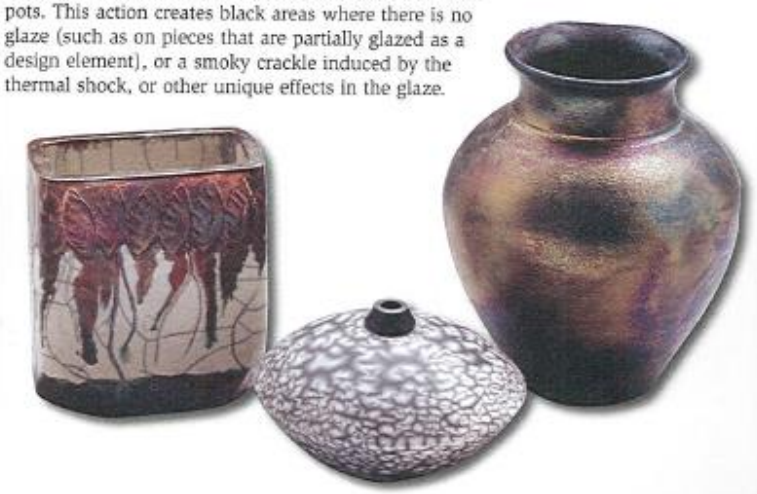
Special Firings

Raku firing and salt or soda firing can be done in any of the fuel-burning kilns, although salt or soda firing should be done in a dedicated kiln because, over time, a thick layer of **salt glaze** will form on the kiln's inner surface. Electric kilns are not very suitable for salt, soda, or raku, because the heating elements in electric kilns are easily damaged when exposed to high levels of sodium or extreme temperature changes.

Raku Firing

Raku firing is a special process invented hundreds of years ago for the traditional Japanese tea ceremony. Raku tea bowls were actually made and used during the tea ceremony. Today, the raku technique is popular with many potters because it enables them to produce unique pottery in a relatively short period of time.

An American version of the raku technique involves first firing glazed pottery at a low temperature in a fuel-burning kiln until the glaze melts, often for only a few hours. Then, when the glaze is molten, the pieces are removed from the kiln with long metal tongs and placed into a fireproof container with sawdust, newspaper, or other combustibles, and covered. The combustible materials catch on fire, but the fire is immediately smothered and the smoke penetrates the surface of the pots. This action creates black areas where there is no glaze (such as on pieces that are partially glazed as a design element), or a smoky crackle induced by the thermal shock, or other unique effects in the glaze.



Also, since the fire is trying to burn, it needs oxygen and takes it from the molten glaze. This reducing activity gives some raku glazes flashes of metallic gold, copper, blue, or green. Raku pottery made with this technique is usually **crazed,** very porous, and not very strong, which makes it suitable only as decorative ware.

Removing pots from the kiln is a hazardous process that requires the potter to wear a special fire suit, protective face shield, and insulating gloves.

If you decide to try the raku technique, you *must* have the supervision of a knowledgeable adult, you *must* wear the protective clothing, and you *must* wear shoes that will not easily melt or catch fire if a pot were to accidentally fall on your foot while being removed from the kiln.

Salt or Soda Firing

In salt firing, the firing proceeds as usual until near the end of the firing, just before the peak temperature has been reached, when sodium is introduced into the kiln. Because the kiln is so hot, the salt immediately volatilizes—the sodium chloride splits into sodium and chlorine gas. The chlorine combines with moisture and forms hydrochloric acid, which eventually escapes from the kiln through the flue; the sodium chemically reacts with the surface of the clay to form a glaze that often has an "orange peel" texture.

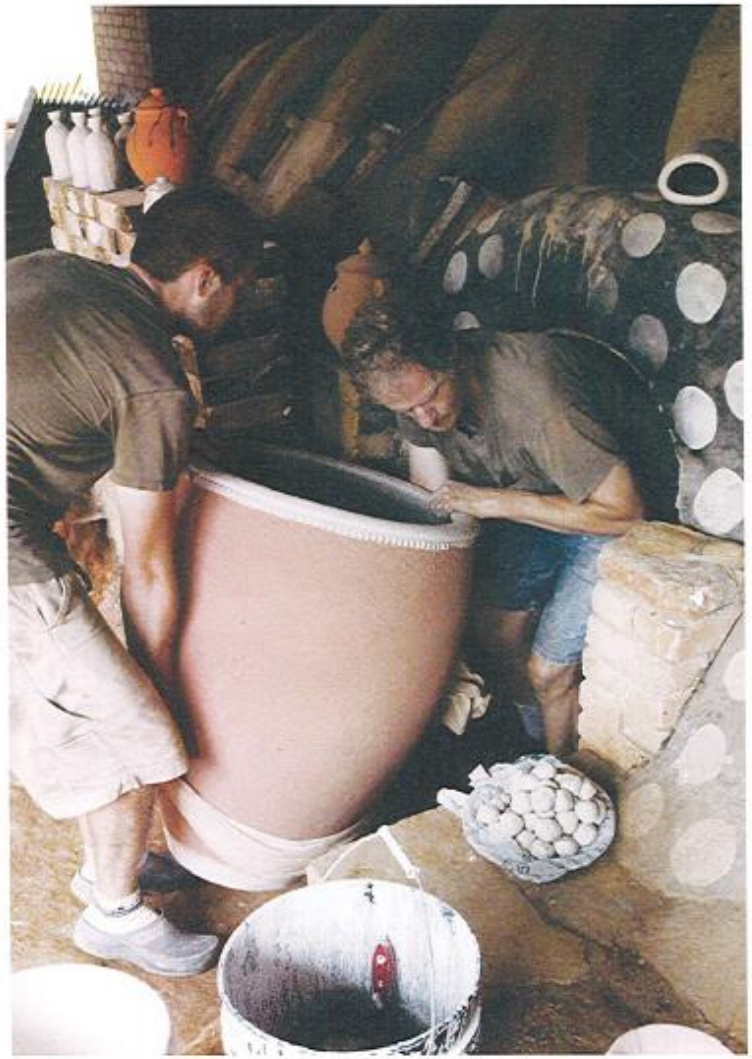
Sodium can be put into the kiln in many ways. You can use regular salt, rock salt, baking soda, washing soda, or any combination of these. Roll it up in sheets of newspaper and throw them in; blow the powder into the kiln with a compressor; or dissolve the sodium in hot water and spray it into the kiln with a garden-type pump sprayer with a metal nozzle.

The fumes produced by salt firing are toxic, and safety procedures must be followed during the firing. Follow the instructions from your merit badge counselor or an experienced potter whenever you are participating in a salt firing.

Baking soda (sodium bicarbonate) and washing soda (soda ash or sodium carbonate) do not change from powder to gas as readily as salt does. Put these substances into the kiln in a dissolved form or mixed with lots of salt.

Peep!

Generally you can tell if the kiln is still hot by touching the outside or by opening the peephole. If heat comes out of the peephole, it is probably still too hot to open the kiln. If it feels warm, but you aren't sure if it is really hot, try this test: Stick some paper into the peephole for about 30 seconds. If it comes back charred or has actually caught on fire, then you know the kiln chamber is still at least 451 degrees, the combustion point of paper, and is much too hot to open.

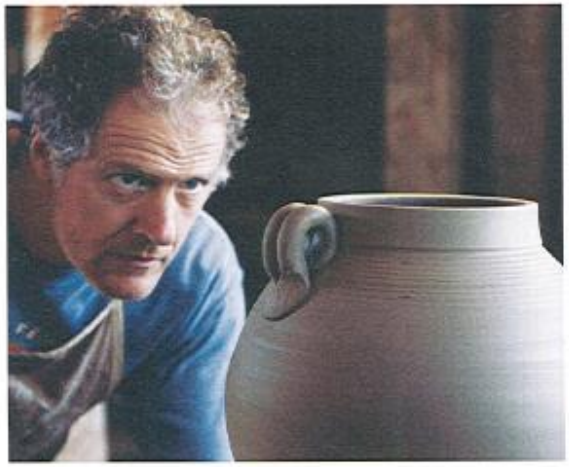


Opportunities in Ceramics

The ceramics industry is one of the largest industries in the United States. Ceramics are useful because of their chemical, electrical, mechanical, thermal, magnetic, and structural properties. The ceramics industry is vital to the successful operation of other industries.

For example, kiln furniture and firebrick refractories are a basic component of the steel industry. Abrasive materials made from silica are essential to the machine-tool and automotive industry. Glass products are essential to the automobile industry and to architectural, electronic, medical, and agricultural industries. Uranium oxide fuels are packaged in ceramic rods for use by nuclear power plants. The chips in every computer are ceramic, as are the tiles that cover the NASA space shuttles.

Even the coating on paper used for magazines and books is ceramic.



A college education is very helpful to gain a thorough understanding of the technical aspects of this rapidly expanding industry. Many universities and colleges offer courses in ceramics, the graduates of which are qualified to work as ceramists or ceramic engineers.

The field of ceramics is extremely diverse, offering many possibilities for employment. You might have an interest in the technical fields—chemical, mechanical, or ceramic engineering. Or maybe you prefer the executive side, such as managing ceramic manufacturing operations. You might be more interested in selling and distributing ceramic products, or you might want to specialize in ceramic art.

Be Prepared

High school courses that will help you gain knowledge important in the ceramic industry include chemistry, physics, math, and shopwork. Give special attention to art because it is closely allied with ceramic design and decoration. Also, a knowledge of machinery and drafting would be of great help. Check with your school guidance counselor.

If you are studying ceramics in school, some practical experience under actual working conditions would be of value. Try to locate a pottery studio in your community, then apply for part-time or summer work there. No matter what task you are assigned to do, you will learn something just from working in the environment and absorbing information.

After Graduation

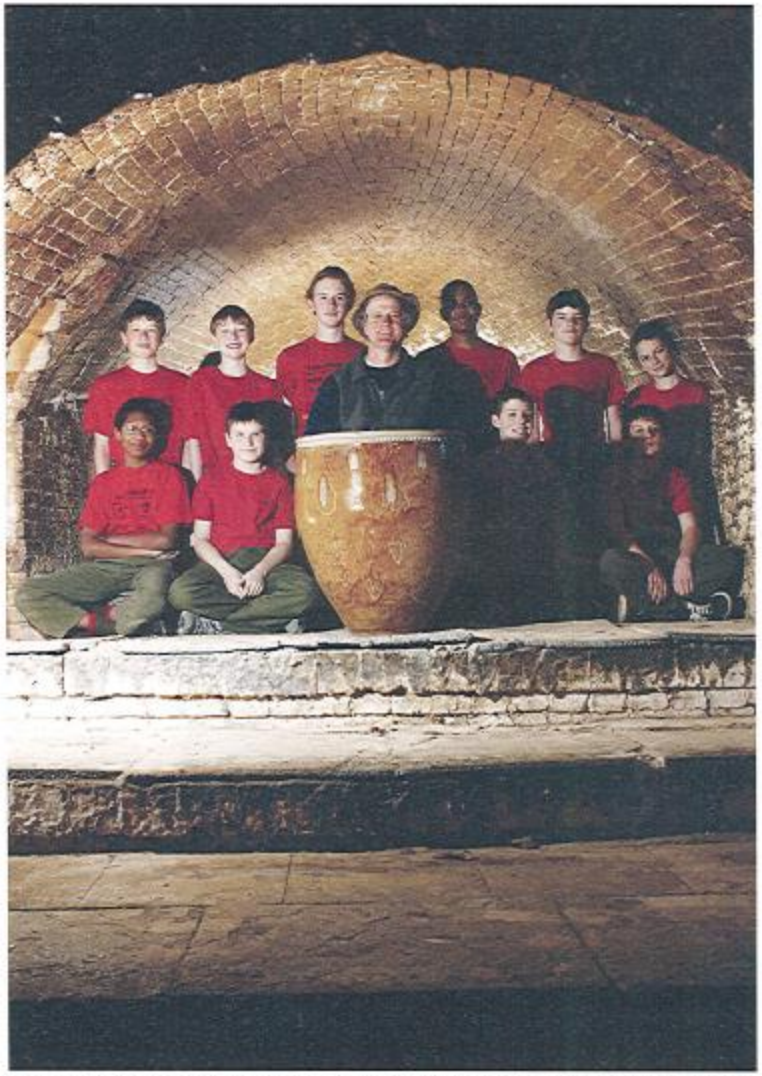
Ceramists and ceramic engineers are concerned with the mining and processing of clay and other nonmetallic minerals and all the products manufactured from these raw materials. Many of them work in research, design, manufacturing, or sales. Some might specialize in such materials as brick, tile, pottery, glass, sanitary ware, enameled metals, abrasives, jet motors, refractories, cements, electronics, and more.

A large percentage of graduates of ceramic coursework are employed in the stone, clay, and glass industries. Other opportunities are in steel, electrical machinery, aircraft, or chemical industries, as well as in education.

Let's not forget the artisan potter, some well-known for their masterful work. Fine examples of pottery are now displayed in world-famous museums; others command high prices at exclusive antiques and art auctions. The most popular designs and styles created by these potters are being reproduced by the world's most respected makers of fine porcelain and stoneware.

Not everyone can create a masterpiece, but that doesn't mean they don't enjoy working with clay and making useful, attractive objects. It never hurts to try, and trying can be a reward in itself. You just might find that you have the creativity and natural ability to become a successful studio or artist potter.

Professional pottery artisans also are often good resources and may be willing to share their expertise.



Potter Mark Hewitt with Scouts inside his massive kiln. It takes six days to load, three and a half days to fire, and seven days to cool. He and his staff fill and fire the kiln three times a year; each firing turns out about 2,000 pieces.

Glossary

Pottery has a language of its own. To know what a potter is talking about, you will need to know the language. Here is a short glossary of some important terms.

bat. A disk or slab of wood, plaster, hardboard, or plastic on which clayware is produced or allowed to dry out. Slightly porous materials make the best bats for pots because they allow the bottoms of the pots to dry. Bats are used on the potter's wheel for large pots that cannot be easily removed after throwing.

bisque or biscuit ware. Unglazed clayware that has been fired once to a low temperature and is still porous.

bisque firing. The first firing, without glaze, to drive off the water chemically combined in the clay, thus making a clay article easier to handle for further work, such as decorating and glazing. (Slips can be used in a bisque firing.)

bone dry. Completely air-dried and not yet fired in a kiln.

burnishing. A finishing technique in which the surface of a clay article is smoothed and polished by rubbing it with a hard object, such as a stone or the back of a spoon.

centering. The process of moving the clay into a symmetrical, spinning axis in the middle of a wheel head so it can be thrown.

clay body. A combination of different types of clay and other substances, mixed according to a formula for a specific ceramic purpose.

clean. To scrape clay with a rib or wipe it with a sponge.

coil-build. To make pottery using pieces of clay rolled like rope.

compressing. The process of pushing the clay down, forcing the clay particles closer together.

crackle. Cracks in a glazed surface, intentionally induced as a decorative element.

crazing. A fine network of hairline cracks in the glaze usually caused by uneven contraction and expansion of the clay article during changes in kiln temperature or during cooling; sometimes intentionally induced as a decorative element.

cutoff wire. A length of wire, usually with a handle at each end, used for cutting clay when wedging or to release the bottom of a clay article from the wheel head.

earthenware. Opaque, porous pottery made from a clay that matures at a low firing temperature; coarser in texture than porcelain.

feldspar. A crystalline mineral used as a fluxing agent in clay bodies and some glaze recipes.

fettling. The removal or correction of blemishes, seams, or other imperfections before bisque firing.

filler. A material added to a clay body to lend strength, determine porosity, and affect shrinkage.

firing. The process of heating clay articles, usually in a kiln, to a specific temperature for a specific time until mature.

flashing mark. An effect on glazed pottery caused by uneven heat during firing.

flux. A melting agent added to a clay body to help the clay particles melt together, or fuse, into a solid material when fired.

foot. The base of a ceramic form.

frit. Ground glass used to make lead salts nontoxic to the skin or certain fluxes insoluble.

glaze. A coating of a glasslike substance that is fired onto a clay surface for decorative purposes or to seal a porous pottery body.

greenware. Formed pottery articles that are not yet bisque fired.

grog. Unglazed, fired clay that has been ground up and added to a clay body to provide texture, increase porosity, lend strength and stability, or reduce shrinkage.

hand-build. To construct a piece of pottery from parts that might be pinched, coiled, slabbed, press-molded, extruded, or fashioned by hand.

heatwork. The combined measure of time and temperature.

kaolin. China clay.

kiln. A special oven used for firing clay.

kneading. The process of working and pressing plastic clay with the hands to help eliminate air bubbles, hard spots, and lumps, to distribute the moisture evenly, and to give the clay a consistent texture.

leather hard. A stage that clayware reaches during drying, when it is stiff enough to be picked up without distortion, yet soft enough to respond to pressure.

luster. A thin film of a metallic oxide applied to a fired, glazed surface, then fired at a low temperature to produce an iridescent effect.

mature. When ware and glazes have reached their proper heatwork—ware has reached its optimum strength and glaze has fully fused.

nonporous. Having no pores or openings to allow liquid to seep through; watertight.

oxide. One of various metal compounds used as colorants in glazes and clay bodies.

peephole. An opening in the side of a kiln for monitoring the pyrometric cones and the chamber during firing.

pinch-build. To manipulate clay by pushing the thumb into it and pressing with the fingers on the outside while turning the clay, creating a hollowed-out form.

porcelain. A high-fired, vitrified pottery with a white, fine-grained body that is usually translucent.

porosity. The degree to which fired clay can absorb water; also, the degree to which liquid can seep through fired or unfired clay.

porous. Having pores or tiny openings that allow liquid to seep through.

pyrometric cones. Little pyramids made of clay and glaze that are formulated to melt and bend as indicators of the temperature reached in the kiln.

refractory. Capable of being fired at high temperatures without deforming; a heat-resisting ceramic material.

salt glaze. A thin glaze produced by throwing salt into the kiln just before it has reached peak temperature.

score. To scrape a series of crisscross lines—using a needle tool, serrated rib, needle, paper clip, or other tool—onto a clay surface that has been brushed with slip. Two clay surfaces that have been slipped and scored can then be welded together.

sgraffito. Decoration by cutting or scratching away parts of a surface layer to reveal the different colored clay underneath.

slip. A creamy mixture of water and clay that is used to weld pieces of clay together or as a decorative element.

stamping. A decorating technique employing a recessed or raised design pressed into the clay.

stoneware. A strong and usually opaque ceramic ware that is well-vitrified and nonporous when fired to a high temperature.

template. A pattern for shaping the profile of a piece.

terra-cotta. A low-fired earthenware that fires to an orange, red, or brown color.

throwing. The process of shaping clay on the potter's wheel.

vitrify. To become glasslike and nonporous.

wedging. The process of mixing plastic clay by cutting it in half and slamming the halves back together to eliminate air bubbles, hard spots, and lumps, to distribute the moisture evenly, and to give the clay a consistent texture.

Pottery Resources

Scouting Literature

Archaeology, Art, and *Sculpture* merit badge pamphlets

With your parent's permission, visit the Boy Scouts of America's official retail Web site at *http://www.scoutstuff.org* for a complete listing of all merit badge pamphlets and other helpful Scouting materials and supplies.

Periodicals

Ceramics Monthly
Toll-free telephone: 800-342-3594
Web site: *http://ceramicsmonthly.org*

Popular Ceramics
Toll-free telephone: 800-331-0038
Web site:
http://www.popularceramics.com

Pottery Making Illustrated
Toll-free telephone: 800-340-6532
Web site: *http://www.potterymaking.org*

Books

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Organizations and Associations

American Art Pottery Association
P.O. Box 834
Westport, MA 02790-0697
Web site: *http://www.amartpot.org*

The American Ceramic Society
P.O. Box 6136
Westerville, OH 43086-6136
Web site: *http://www.ceramics.org*

The Pottery Studio
Web site: *http://www.studiopottery.com*

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Thanks also to the Craft Guild of Dallas and its staff for so generously allowing us the use of their facilities for a photo shoot. For more than 50 years the Craft Guild has served as a meeting place for hobbyists and artists, and as a showplace for their works of art.

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Photo and Illustration Credits

Dave and Keiko Hergesheimer, courtesy—page 5

W. M. Hewitt Pottery, courtesy—pages 39 *(both)*, 40 *(top)*, 86, and 88

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NASA, courtesy—page 10 *(left)*

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Wikipedia.org, courtesy—cover *(Asian vessel in bottom center, Ming vase in bottom right, Staffordshire ware in center left)*; pages 11 *(both)*, 13–14 *(both)*, 17 *(all)*, 18 *(bottom)*, 19–20 *(all)*, and 27

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Dan Bryant—cover *(cone pack)*; pages 7, 18 *(top)*, 25 *(bottom)*, 26, 32, 38, 42–57 *(all)*, 59–62 *(all)*, 64–66 *(all)*, 68, 70–71 *(all)*, 73–74 *(all)*, 78–79 *(all)*, 83, and 85

John McDearmon—pages 12, 35 *(all)*, and 67 *(bottom)*

Randy Piland—page 89 *(right)*