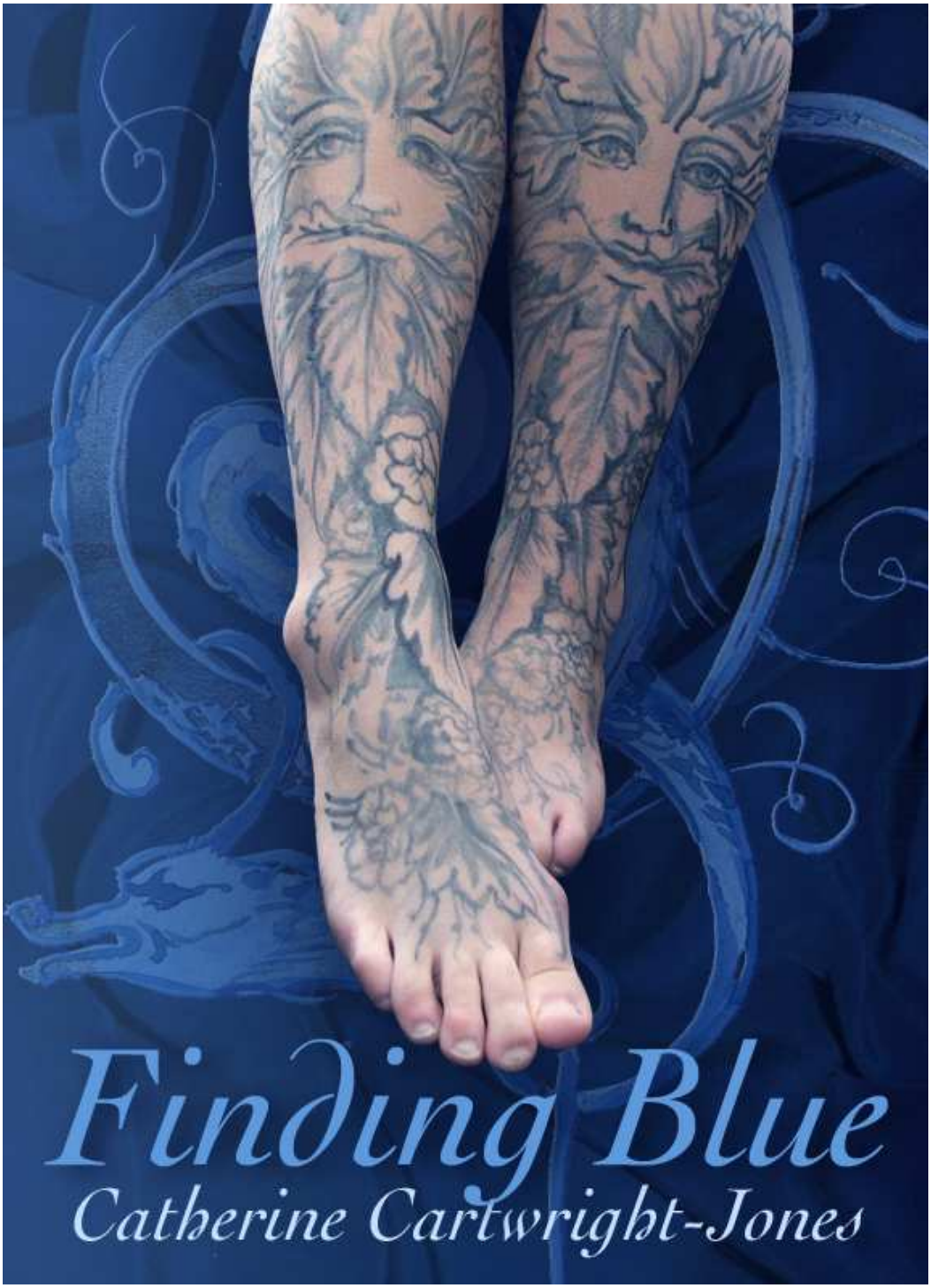


Science

The Vat: the Secret of Blue

Indigofera and woad plants are the source of natural blue dye. The indigo dye is not produced directly in the plant. The plants produce precursors which can be transformed through fermentation and oxidation to blue indigo. Dyers shred and compost Indigofera and woad leaves to free the precursors from the other plant material. Then, the composted plant material is fermented in an alkaline vat. This produces a soluble precursor molecule which will stain cloth and skin. Once the precursor molecule is outside of its alkaline vat, and comes in contact with air, it changes back to the insoluble blue indigo molecule.

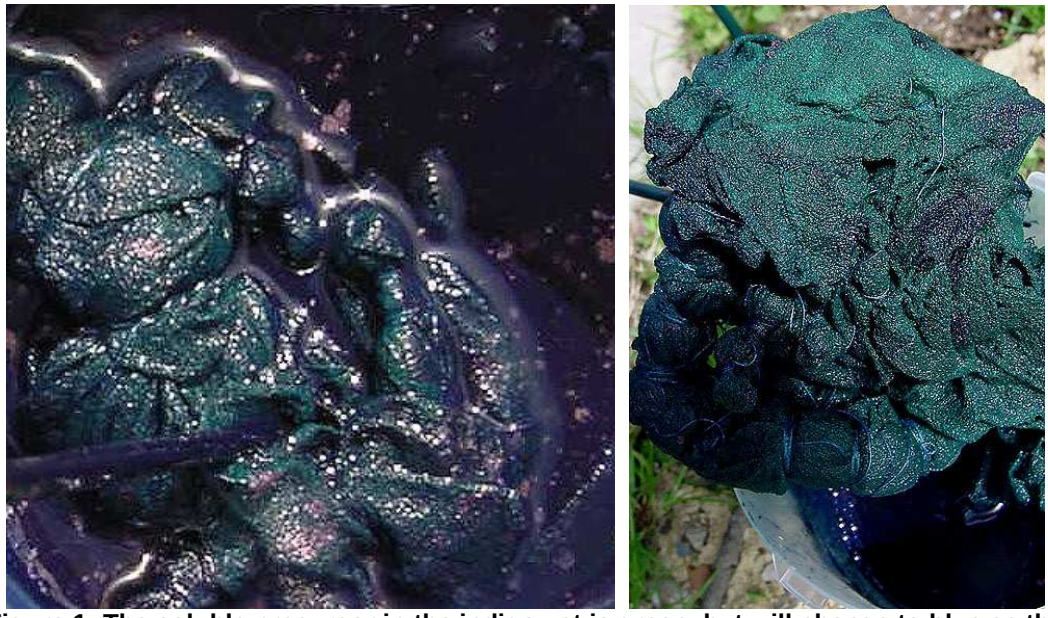


Figure 1: The soluble precursor in the indigo vat is green, but will change to blue as the molecules gather oxygen from the air.

Figure 2: The green stains on cloth and skin change to stable insoluble blue.

Why Was Blue Lost?

Since the late Neolithic, indigo and woad were the source of blue dye. Indigo was first cultivated and developed in India, and woad was first cultivated and developed in Europe. Both were economically important industries, for domestic use and export. India exported processed indigo across the Roman Empire by the first century. Processed woad was traded across Europe. When sea trade routes opened up in the sixteenth century, indigo from India entered the European market and the production of woad gradually went into decline, because more dye can be produced from indigo than the same amount can be from woad.

Woad processing is labor intensive, and produces a horrific odor. Woad vat produces methyl sulphide among other volatiles: the stench is of decomposing cabbage, urine and rotten eggs. A woad vat was unwelcome in English towns, even in the fragrant middle ages.

With the decrease of woad production and the dismaying smell of woad vat, there was little chance for any scholar to test the theory that blue body art might have been created with woad. Coupled with the academic disinterest in body art, the lack of investigation of the potential for woad as a Celtic material culture was complete.

The German chemist Baeyer synthesized indigo in 1880, and in 1897 BASF developed commercial manufacturing of synthetic indigo from o-nitrobenzaldehyde and acetone with dilute sodium hydroxide and barium hydroxide or ammonia. Indigo and woad production rapidly fell into disuse. By 1913, synthetic indigo had almost complete replaced indigo. The traditional craft of cultivating woad and indigo and producing dye vanished except for a few remote areas where synthetic dyes were unavailable.

Very recently, there has been a resurgence of interest in plant-based dyes based on finding of environmental damage from synthetic dyes. One area of interest is indigo. Modern scientific method has developed efficient means of inoculating indigo plant slurry with the appropriate bacteria, adjusting it to the correct PH, and maintaining the correct temperature to create the vat. This dye vat can then be freeze-dried into crystals, just as brewed coffee can be freeze-dried to be ready-made coffee.

Figure 3: Ancient Blue™ is made from the indigo plant

This freeze dried vat is sold as Ancient Blue™ at mehandi.com, and is what I have used in this book for experimental body art. Add water to the crystals, and you have a vat, ready to use, exactly the same as if you had grown the plants, fermented them, and gone through all the traditional labor. Beyond convenience, Ancient Blue™ has the advantage of having very little odor. Even though these crystals are derived from indigo plants, the molecules and the results of the vat is almost identical to a woad vat (just as sugar from a beet is identical to sugar from sugar cane). No other form of indigo or woad currently available can easily be made into a vat and used for body art.

Make the Vat

Figure 4: Make a vat of Ancient Blue in a shot glass. Fill the shot glass 1/3 to the top water. Then add 1/3 teaspoon of Ancient Blue.

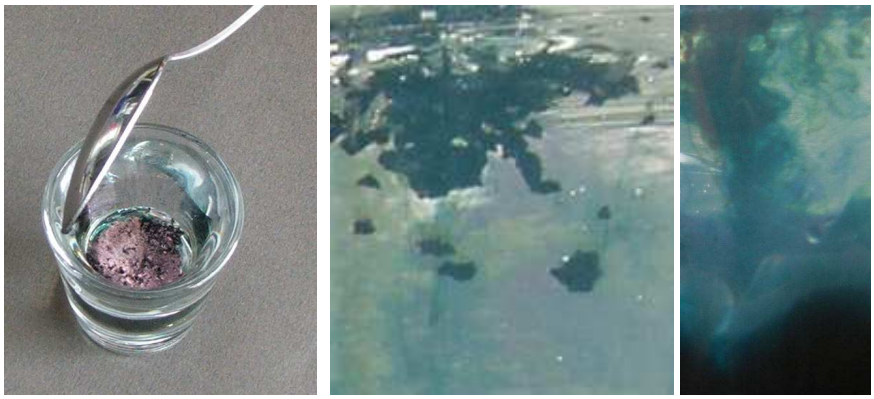


Figure 5: Drop the vat crystals into water.

At this first moment, you can see the green precursor as the crystals enter the water. Do not stir the crystals into the water! Just let them settle to the bottom. The oxygen in the water turns some of the green precursor to blue indigo.

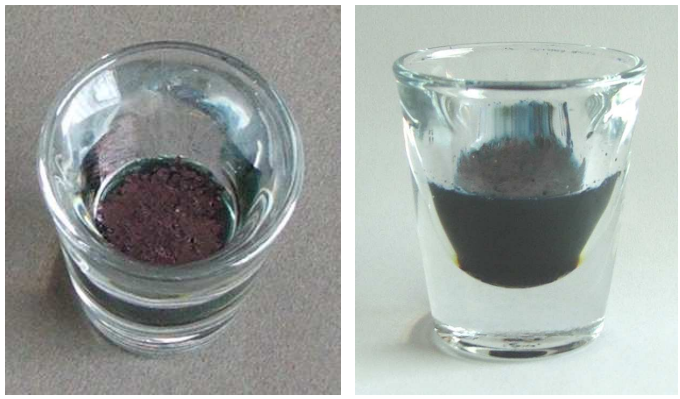


Figure 6: Scum will form on the top surface of the vat in about 1 minute.

The vat is dark green under the scum, and oxidized dark blue insoluble indigo on top. The blue scum protects the green alkaline vat from contact with oxygen. Disturb the scum as little as

possible: if oxygen gets into the vat, it won't stain your skin. When you see that scum, you know your vat is ready.

You can get good stains from little vat for about half an hour. There's no reason to make a vat larger than you can use up in less than an hour, so a half a shot glass of vat is enough to use and not wasteful. You can't make your vat in something wide, like a saucer, because oxygen contact at the wide surface would spoil the vat.

What do you need to find blue?

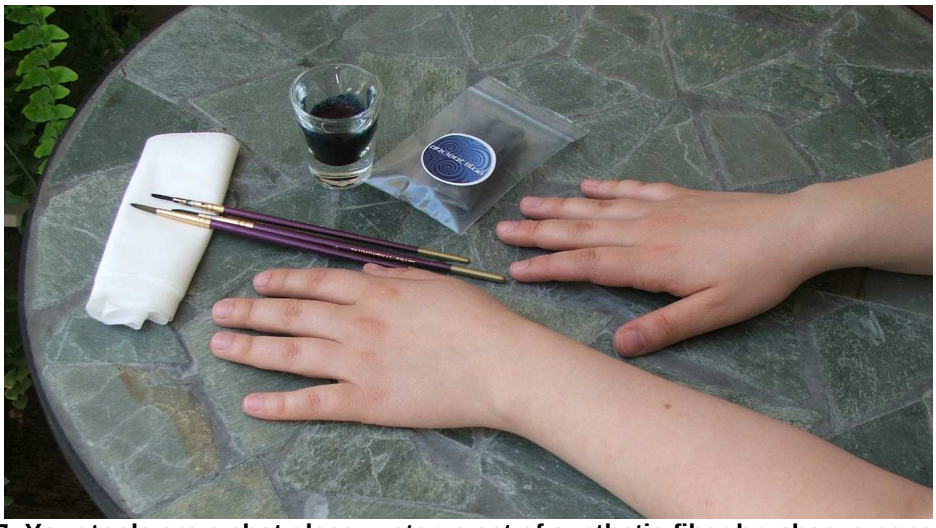


Figure 7: Your tools are a shot glass, water, a set of synthetic fiber brushes, a paper towel, Ancient Blue™ and clean skin

Do not stain broken skin: this can leave permanent blue spots. Do not stain delicate skin: the vat is alkaline and may irritate tender places. Do not use vat anywhere near eyes, mouth, ears, genitals, or on children. Stain only healthy, mature, intact skin.

Figure 8: You'll need running water, a few drops of liquid detergent or soap, and some old towels.

You can rinse in a sink or with a garden hose. You must have plenty of water to flush the superficial indigo off the skin, and towels to dry afterwards. If there is a blue haze on the skin after rinsing, a few drops of dishwashing liquid in the rinse water will clean the area. Use old dark towels to dry the skin: don't use new white towels that may get stained.

Work outdoors, or in some area that you can clean up from an accident. The crystals and the vat will stain linoleum, wood, cloth, concrete, plastic, vinyl, and any other permeable surface. You can remove the stain with plenty of water and bleach, but clothing, rugs and carpets will not survive the bleaching and washing.

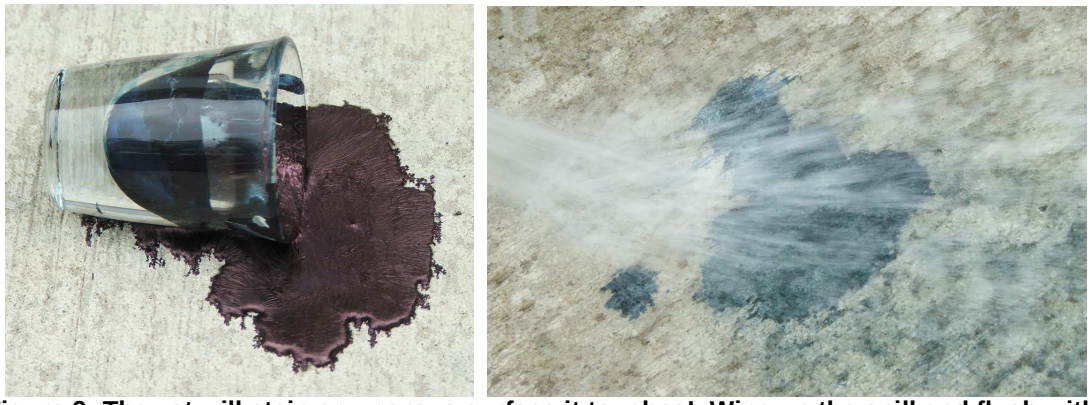


Figure 9: The vat will stain any porous surface it touches! Wipe up the spill and flush with plenty of water.

Figure 10: Pour laundry bleach full strength on the stain, and let it dry. Rinse again. After two or three bleaches, the blue will be completely gone.

If you have an accident, stop and immediately clean it up. Curious children and pets can spread the blue stains and make a larger mess.

If you spill crystals on a carpet, floor, clothing or furniture, vacuum them up quickly and thoroughly. Even dust from the crystals can make intense stains. If you try to wipe them away with a damp rag, this will activate the vat and make the stain difficult or impossible to remove.

Ancient Blue will temporarily discolor porcelain and steel sinks, but the color is easily removed with a tough sponge and scouring powder.

Keep Ancient Blue™ indigo crystals and vat away from children and pets, and anyone else who doesn't understand that Ancient Blue is very concentrated alkaline dye and will stain everything it touches!

Use the Vat

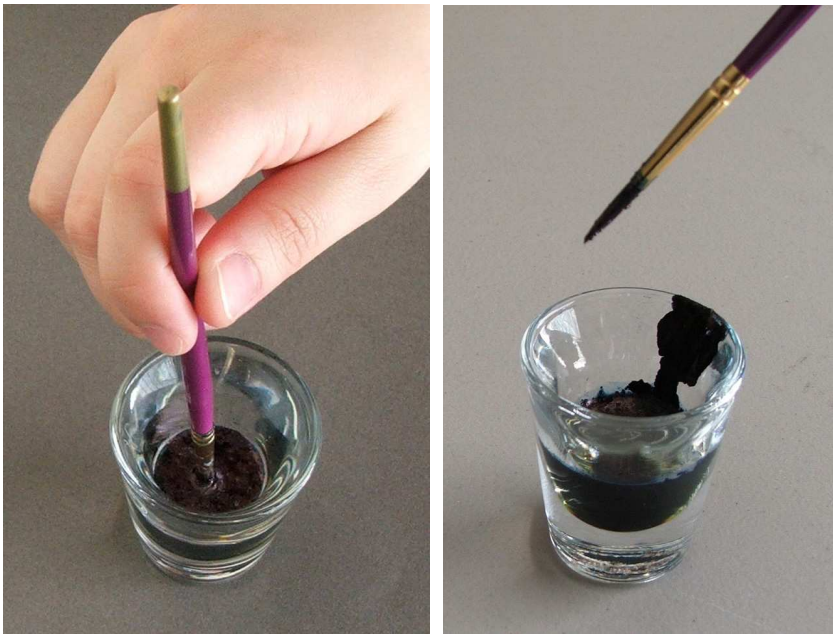


Figure 11: Pierce the scum with your brush so your brush takes up a few drops of the green vat beneath. A little oxidized scum will cling to the brush. Wipe it on the inside of the cup so you can make tidy brushstrokes.

Do not stir the vat. Do not swirl your brush in the vat.

Figure 12: Do not use natural hair brushes. Use synthetic hair brushes.

Natural hair brushes get damaged and fuzzy in the alkaline vat. Use good quality synthetic hair brushes designed for watercolor painting. They will keep their shape, and are less expensive.

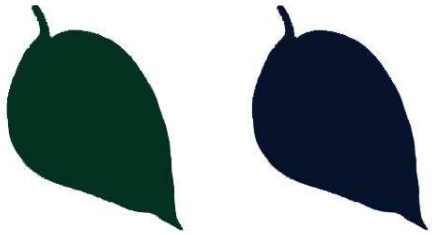


Figure 13: When you first brush the vat onto skin, you may see dark green which instantly turns dark blue. That dark green vat stains the skin instantly. Leaving the indigo on the skin longer won't improve the stain. The dark blue powder left on the surface of the skin must be washed away. It will soil clothing and anything else it touches.

Figure 14: When you rinse the superficial pigment from the skin, the color will appear much lighter. It will be darker where the brush first touched, and lighter where the brush last touched.

Figure 15: When you have rinsed away the first application, dry the skin. Then, paint the details and accents. The second application will be slightly darker than the first. When you rinse the second time, the stain will be many tones of blue.

Figure 16: If there is little or no stain after you rinse, the vat may have gotten oxygen into it, or the skin may have resisted stain. A little glass of vat may be useless in one hour from dipping the brush in and out. Make a fresh vat, clean the skin with a few drops of dishwashing detergent and lots of running water, and try again.

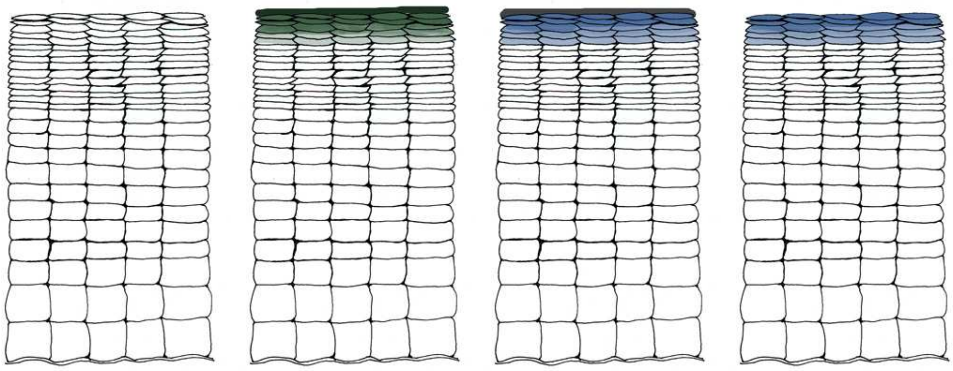


Figure 17: Diagram of indigo staining in the skin

The moment indigo vat is applied to skin the precursor penetrates the outermost layer of the skin. Vat immediately stains the top layer of skin deep green. In moments, the vat oxidizes and dries to a blue-black powder on the surface of the skin. The skin cells that were stained with vat oxidize to blue. When you rinse the black powder away, you can see the blue stained skin. This blue layer is shallow, and will exfoliate in a few days.

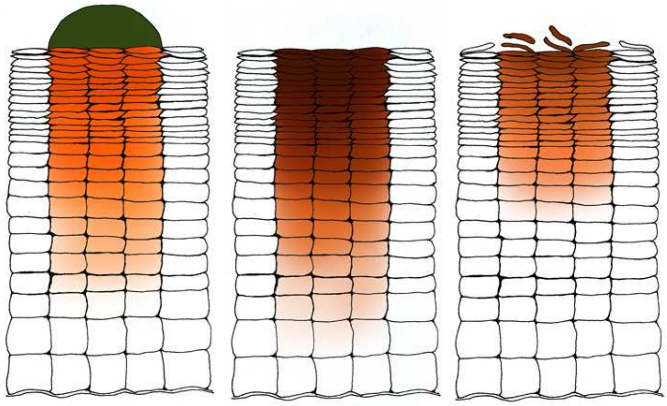


Figure 18: Diagram of henna staining the skin, then fading

Henna is very different from indigo and woad vat and does not stain the skin in the same way. Lawsone, the dye molecule in henna, is present in the plant leaf and paste, so there is no need for fermentation in a vat to create the dye. When you put henna paste on skin, the lawsone molecule migrates from the paste into the skin. Henna stains penetrate the skin to a greater depth than blue, because the lawsone molecule is half the size of indigo. The longer you leave henna paste on the skin, the greater the stain saturation and the darker the stain. Prolonged exposure to indigo vat does not improve the blue stain on skin; it only irritates the skin.

Both henna and indigo stains exfoliate as skin regenerates from lower layers. During this process, the stain will appear to fade. The stain is not actually fading: less saturated cells are rising to the surface. Henna stains disappear in one to four weeks. Indigo stains disappear in one to ten days.

Vat is not paint because it penetrates and stains the skin. This is not a tattoo, because it does not pierce and permanently remain in the lower dermal layers.

Apply Blue

Figure 19: The dye will be deep green when it first touches the skin, then it will turn dark blue. Work quickly. The dye in the brush will oxidize in less than a minute. Then, you'll need to dip into the vat again.

Make the first application loose and free, as if you are sketching. Don't worry about making mistakes. Much of the blue will rinse away.

Figure 20: The first application is ready to wash away.

Do not leave the Ancient Blue on the skin any longer than is necessary to complete the pattern. The stain won't get any darker with longer exposure. As soon as you have the first painting done, rinse off the superficial pigment.

Figure 21: Wash with plenty of water and a few drops of dishwashing liquid or soap.

The excess rinses away quickly with water. Clear away the blue "hazing" with a little soap or a few drops of dishwashing liquid and lots of running water. Pat the skin dry with an old towel.

Figure 22: The superficial pigment is rinsed off; the stain remains in the skin

Now you can see how the skin is taking up the blue. Some areas have a dark stain, and some have a lighter stain. Some areas feathered and others held the lines firmly. Skin may resist the blue if toughened from the sun, or oiled with lotions. Soft skin which has been protected from the sun and wear takes up blue most easily and evenly.

Figure 23: Add depth and detail with your second application

Skin is an uneven terrain. Work the skin's variation to your advantage: use the areas of stain and resistance creatively.

Apply the second blue just as you did the first. Use the areas of darker stain to add detail and clarity, and the areas of lighter stain to let the pattern drift into the background. If you let the blue guide you, the finished work will have a rich "natural" appearance with subtle gradation like a watercolor painting.

Figure 24: Rinse again to see the final stain. This blue will gradually fade in five to eight days.

Many people say they wish they could keep the dramatic black color on their skin. The black will smear and rub off on clothing, and leaving it on the skin longer won't improve the stain. Leaving the black on longer may irritate the skin because it is alkaline. Blue doesn't conform to the rules of tattooing and henna. It has to be appreciated for its own subtle, unpredictable beauty.

Stain and Skin

Figure 25: After the first rinse you can see darker stains made when the brush was fresh from the vat.

The darkest lines, 1 and 2 were made the moment after the brush was pulled from the vat. The medium leaves, 3 and 4, were made about 10 seconds later. The palest stains, 5 and 6, were made about 30 seconds after the brush was dipped in the vat. At 30 seconds, most of the vat precursor had changed to insoluble indigo and would no longer stain the skin.

Figure 26: There may be areas where the stain creeps along wrinkles in the skin, such as knuckles or wrists. Paint very carefully in wrinkled areas, or avoid them entirely.

Figure 27: There will be areas, such as the palm, where the stain is very dark.

Figure 28: Emphasize those areas which stain well in your second application.

Figure 29: Though the stain on the palm is usually dark, it will only last three days.

The stain on the arm will last nearly a week. Adjust your pattern so it will fade gracefully across the different areas.

Figure 30: There may be areas where the stain is poor.

The stain may not penetrate areas that have been moisturized or frequently exposed to sun. Some skin is just inexplicably resistant to stain.

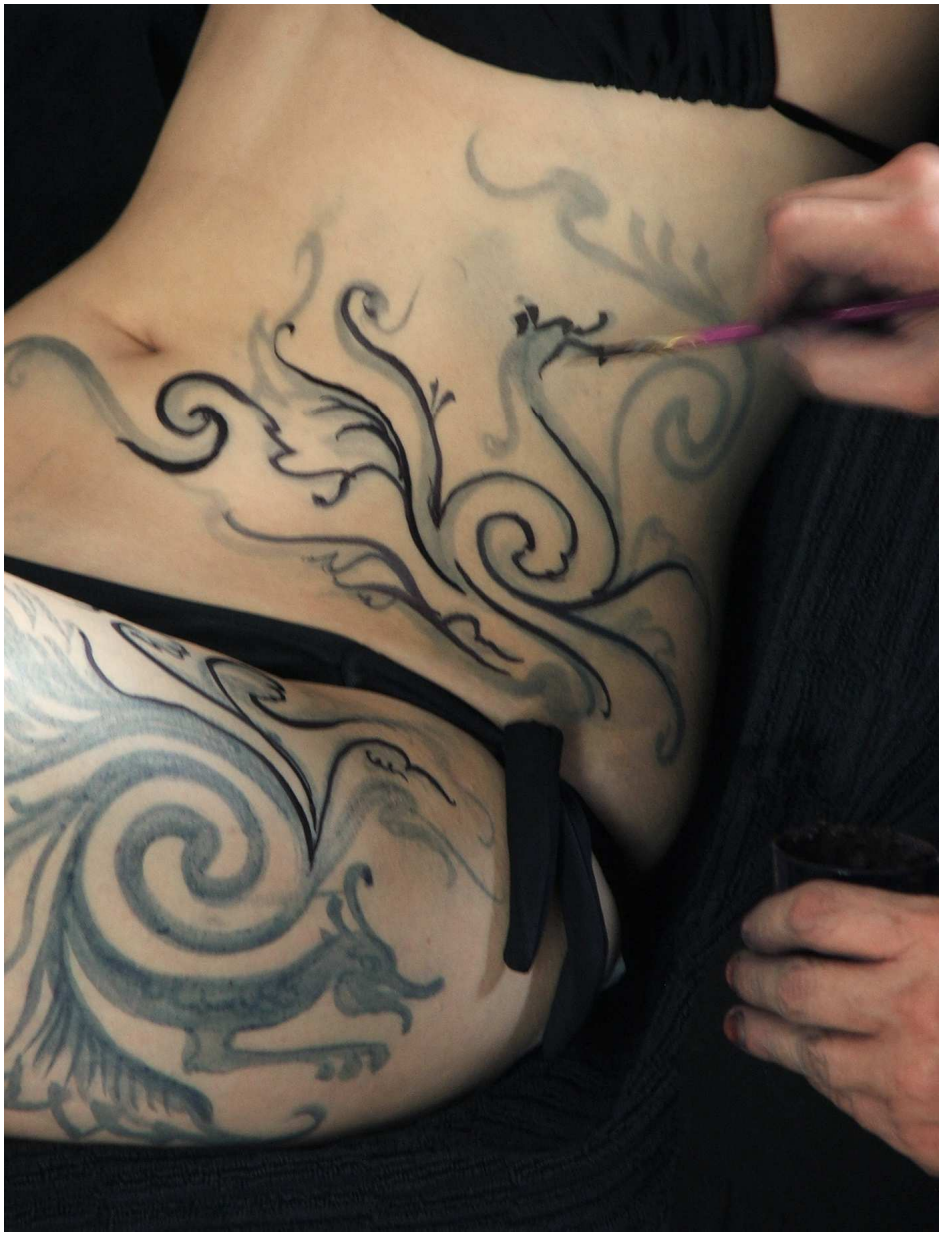
Figure 31: Use your second application to emphasize and define the best stain areas and minimize the poor stain areas.

Darker Skin

Figure 32: Indigo stains on dark skin

Indigo has a slightly different appearance on darker skin, but it stains just as well.

Full Body Blue:



Ancient Blue™ stains arm, legs and torso skin easily. Palms and soles take darker color, but the stain only lasts one to three days. Arms, legs, and torso stains last five to ten days. Though there are traditions of staining the face and vulva blue with indigo and woad, Ancient Blue™ is a highly concentrated and alkaline vat and should not be used to stain the face or other tender areas of the body.

Before you begin work, wash the skin thoroughly with hot water and dishwashing liquid or bubble bath. Naturally oily skin or moisturized skin will resist stain. Skin must be clean and dry before you work. If you rinse the first application and find areas which completely resisted stain, wash again with more dishwashing liquid, and try again.

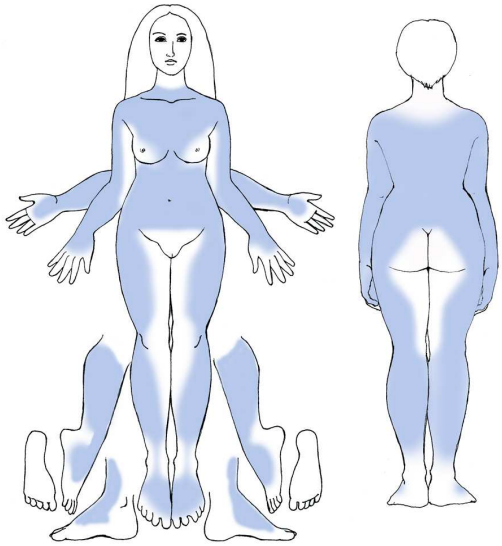


Figure 33: Avoid staining areas where the skin is thin, sensitive, hairy, wrinkly, calloused, or difficult to rinse quickly and easily.

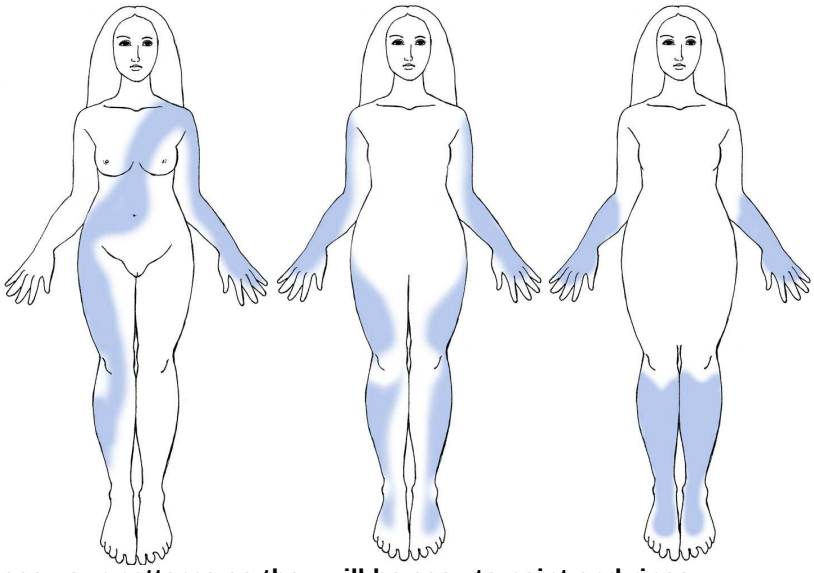


Figure 34: Place your patterns so they will be easy to paint and rinse

People who are comfortable will more easily hold still while you work. Adapt your patterns to what can be easily and thoroughly rinsed. People who are nude or in a bikini may lie on a mat; sit next to them to paint the patterns. They can rinse in a shower, though they may need assistance getting the superficial indigo rinsed off evenly. If the people are clothed, you'll have to work around the clothing, and in areas which can be rinsed without staining the clothing in the indigo rinse water. A carefully aimed garden hose will wash most areas. In cold or fully clothed situations, or where a sink is the only source of running water, lower arms and legs are easiest to stain blue and rinse.

Rinse thoroughly with plenty of water and a few drops of dishwashing liquid. Rinsing the superficial indigo may leave a blue haze or blue trickles on the skin: a little dilute detergent and another rinse will clear that away.