Teaching Ecological Literacy to Grades 1-5:
Restoration Dye Gardens

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This manual teaches to the following California State Standards:

SCIENCE	VISUAL & PERFORMING ARTS
1st Grade: 2.a, 2.b,	1st Grade: 1.1
2nd Grade: 3.e.	2nd Grade: 1.1
3rd Grade: 3.a, 3.d	3rd Grade: 3.2
4th Grade: 3.a and 3.b	4th Grade: 2.4
5th Grade: 3.e	5th Grade: 3.3, 4.2

Can You Make Friends With Plants?

Native plant nurseries in your area can help you find the right plants for your site. Native plant dye recipes for bioregions across North America can be found in the book **Harvesting Color** *by Rebecca Burgess.*

BACKGROUND

Before students begin handling a plant species, i.e. planting it, pruning it, etc., it is important to prepare them for the process by talking about respect and kindness in a tangible manner. Helping children personally identify with the plant species ensures a strong foundation of empathy to increase students' attentiveness and encourage them to take greater care in their work.

PROPS

Native plant start- California sagebrush
Drawing paper
Pencils

VOCABULARY

Artemesia californica
Proximity

LESSON ACTIVITY

Students are asked a series of questions to engage in the conversation of plant/human relationships.

Q: What makes a good friend?

Responses often include time spent together, i.e. play dates or recess games, kindness, living near each other. These are examples of responses that you can use and write on the board.

Q: Can a plant be your friend?

Initial responses often include laughter, some no's and yes's.

Q: How could you become a good friend to a plant? What does a plant need to stay healthy?

Hold up a plant start to help students connect.

Responses often include- water, dirt, sunlight, these are crucial and should be collected for future reference.Some of the responses for 'what makes a good human friend' are good answers to this question. Have students think about proximity- do you think you will take better care of a plant if lives far away from you- or if it lives nearby? Being kind to a friend means spending time with them- do plants need us to spend time around them? What does it mean to be nice to a plant? *Collect responses to refer back to for later use.*

FINAL DRAWING ACTIVITY

Place students in a group, where they have visual access to the plant. Have students draw what they see, and have them put the scientific and common name at the base of their drawing. These "scientific" drawings can be added to a "restoration garden journal," or turned into a handbook (see example in back of this manual).

11,000 Years of Life in California?

California Indians harvested tule for a range of uses, including lightweight and watertight boats that were used to travel around the region's vast waterways.

BACKGROUND

We can all look to California Indians as an incredible resource for plant knowledge and land management. By investigating a very simply constructed timeline (instructions attached), students will begin to understand their lives as part of the continuum of human history in their region. They will also begin to perceive the different levels of experience that past societies had with these plants.

PROPS

Native Plant Starts
Images of Miwok (Fig. 1-3, below)
Timeline (Fig. 4, below)
Paper and pencils

VOCABULARY

Coast Miwok

LESSON ACTIVITY

With students in a circle, stretch the timeline out and indicate the place where most of them were born. Show them the place where you were born.
Point from the beginning of the timeline and draw your finger across the paper through to the year 1850. Explain that this is the amount of time humans have lived on the land their school is now on. These people, who lived here for so long are called the Coast Miwok, and many of them now live throughout Marin and beyond. Use figure 1 to show a tribal member actively engaged in normal daily activity; this woman is from the Pomo tribe, from the territory bordering the Coast Miwok.

California Indians constructed some of the world's finest baskets. Some were so intricate that they could be used for cooking or to hold water.

Q: Referring to the period before 1850- were there grocery stores? Doctors offices? Clothing stores?

Q: How did the Coast Miwok create medicine, food, clothing and tools?

Responses often include: from the earth, from a forest, from someone else. Expand on the 'earth' or 'land' responses; ask students what on the earth or on the land provides food, medicine, and clothing? Students often suggest plants like tomatoes, corn and other horticultural varieties. Tell them that there were no farms like we see now, and tomatoes, corn, and other common edible plants weren't even here yet!

Pass around a native start (CA sagebrush), and share with the children that plants like these were here long before their school existed. Refer to the timeline and tell them that we would need one long enough to wrap around our school many times to show how many years this plant has been living on the land. These are the plants that

Students investigate the restoration site where the planting process will take place.

the Coast Miwok used for medicine, food, and clothing. California sagebrush was used to make tea, to cure headaches, and help heal an aching belly.

Show pictures of the iris fiber shoe [2] and willow basket [3].

The lesson should finish with a visit to the place in the school garden or to the pots where you intend to plant your first native start, followed by a concluding drawing activity.

Q: Referring back to students responses to 'How to make friends with plants' (lesson 1), ask students about the placement— 'Is this a good place for our plant? Why or why not?'

Placing the plant in its intended location and leaving it there for several days prior to planting allows you as the teacher to assess the spot along with your students, based on their own suggested guidelines. (Will we remember to water it? Does it get bumped or stepped on? Etc.)

Important factors to consider in response to this question:
Is there water nearby? Would the plant be near the area where students' daily activities take place? Will we be able to see it from our classroom (proximity)? If not, how will we set up a system to take care of and watch over this plant?
Native Americans used the most common plant species to sustain their material culture; very rarely did they rely on scarce species. They made the most use of the plants closest to their human domain, and took great care of their 'plant neighbors' to make sure their people would have a consistent supply of materials, whether they be for food, medicine, or art-making tools.

FINAL DRAWING ACTIVITY

Ask students to draw the plant in its new home. If you are keeping a garden journal, students can add this image to their documentation.

Fig. 1 Woman Seed Beating

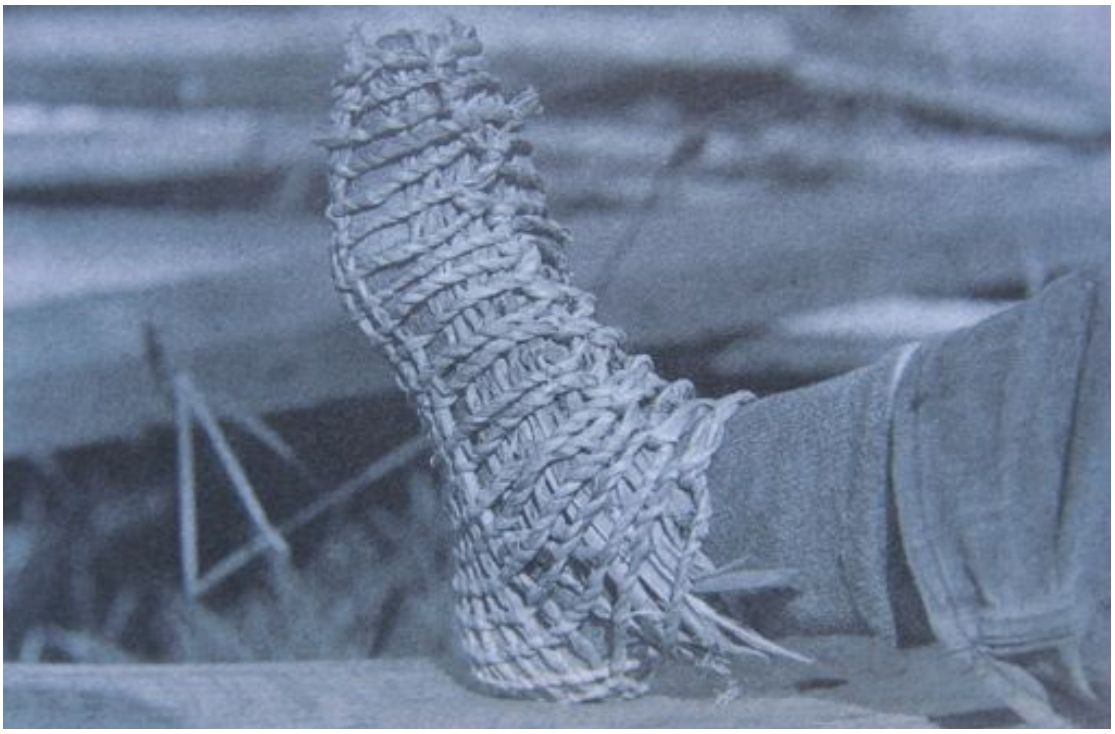


Fig. 2 Iris Fiber Shoe

Fig. 3 Willow Basket

9,000 B.C.E Human life begins in California

Cut out strips along the dividing lines; you should have ten 1” by 11” strips, where 1” in length= 100 years of history. Place end to end chronologically to create a timeline of human history in California.

Experiments With Water

A student's garden map from a sample restoration journal.

BACKGROUND

All flora and fauna depend upon access to an available water supply for survival. When scientists evaluate a distant planet for its ability to sustain life, they look for water first and foremost. Humans are currently utilizing fresh water resources at an unsustainable rate; the International Monetary Fund has stated that by 2020, we will have exhausted fresh water resources to the point at which our global demand will exceed availability by 40%. How can we teach students to manage water resources? Enhancing our planet's ability to hold fresh water is key to sustaining life on earth

PROPS

Plastic lids from storage boxes
Small Scale play houses, animals, and play silks
Sponges
Watering can with a 'rain' feature
Measuring cup
With these materials, create two model landscapes for your students. The first should include model houses, animals and play silks [5]. The second should include all items listed above, and sponges [6].

VOCABULARY

Absorption
Aquifer
Rain Water Cycle
Run-off

If students need a preliminary lesson in the water cycle, there are many teaching aids available. Drippy the Rain Drop makes a wonderful accompaniment to this experiment: http://www.drippytheraindrop.com/)

LESSON ACTIVITY

The teacher leads students in a visual simulation, which will demonstrate how soil can catch water and pull it down into the earth, creating a pool or aquifer. If an aquifer is kept full, it sustains the water in our rivers and creeks. The aquifer is a pool of water that we can draw from for our own needs, and is also vital to the health of trees, plants, mammals, birds and insects.
This activity will help students visualize the distinction between soft, absorbent soil and hard surfaces, such as concrete, hardpan soils, or asphalt. Students will help the teacher measure how much water runs off of the hard surface versus the soft soil, with the use of a watering can (rain) and measuring cup.

Q: Ask students, 'Where do rain drops go once they land on the earth?'

Every year we lose 1% of our topsoil globally, equivalent to about 25 billion tons.

"Despite their artistic pretensions, sophistication, and many accomplishments, humans owe their existence to a six-inch layer of topsoil and the fact that it rains." -Anonymous

Q: What is harder: sidewalk or dirt? What is harder: rooftops or dirt? If you want water to sink into the earth, is it better for raindrops to land on the sidewalk, a rooftop, or dirt?

Propose to answer these questions by performing an experiment that will show how water is absorbed in two different environments.

Have students count to 10 as you pour water over the first 'town' full of hard soil and concrete with the watering can. Drain the water you've collected into the measuring cup and record the quantity of water for students to see. Repeat this exact process for the second 'town' with the spongy soils. Drain the water you've collected into the measuring cup (do not squeeze the sponges of water into the cup), and write the quantity of water down on the board for students.

Q: The same amount of water was released onto each 'town', but different quantities of water were collected. Why is this? Where did the water go from the second town?

Students often respond by asking you to squeeze the water from the sponges into the measuring cup, which they believe explains the difference in water quantities. They are correct.

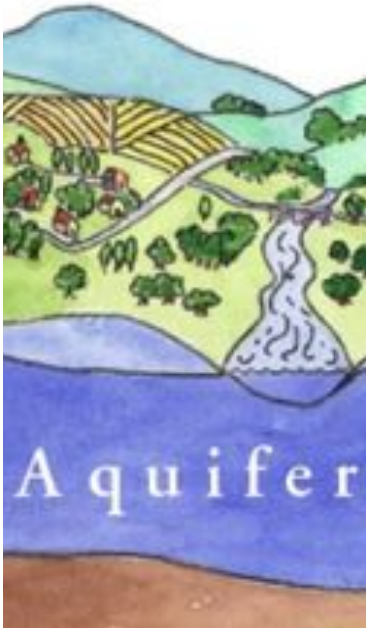
Q: As you hold up the sponges ask the question: What is the soil like in this town, the town where the water has remained?

Students often respond with, 'the soil is like a sponge,' or 'the soil can hold the water.' You can modify and clarify these responses and introduce a new vocabulary word- absorbent
The water held in the sponge is like water held in the earth's soft soils.

Q: Where will this water go if it keeps moving down through the spongy and absorbent soil?

This is a good time to draw a diagram on the board of a slice of the earth's surface. A town can be drawn on the top a few layers of dirt--students can draw their own diagrams in their restoration journals. Concrete and cement prevent water from being absorbed into soils, which leaves the water to run off quickly towards the ocean, or form puddles and evaporate. Poor soils also do not absorb water well. Human development, human landscaping, and over-grazing by farm animals cause soil compaction and erosion. It is important to take good care of our dirt—we can help our soils stay intact by keeping them well planted with native flora that establishes healthy root systems. Keeping unplanted, bare soil well covered with mulch or straw can mitigate water and nutrient loss, and help prevent erosion.

Show an image of a garden and the mulch surrounding each plant [7].



Sample aquifer diagram retrieved from: http://www.emporia.edu/earthsci/amber/students/shirley/

Fig 5. Model Town with Hard Surfaces

Fig 6. Model Town with Soft Soil

Fig 7. A well-mulched plant.

LESSON 4

Drop in the Hand

A student places a flag in a zone she has built up with straw. It is an erosion-protected area with a slight elevation, and will be a good spot for woodland strawberry. The suitability of different sites to different plants will become clearer in Lesson 5, when students have been exposed to plant personalities.

BACKGROUND

When choosing a site for your garden, it is important to consider that water always flows towards the lowest point. Observing the terrain during the rainy season to see where soil drains and where water pools is an excellent way to evaluate a site. Does your soil drain well, does it cause water to pool, or do levels of absorbency vary? Areas that remain walk-able and dry during rainstorms typically drain well. Some plants prefer to live in damp areas, while others prefer dry terrain.

Before our natural environment was cultivated and water channeled through drains and pipes, soils directly absorbed the rain. The water was distributed naturally through areas that percolated well, and through other areas that held water in pools. Lands that hold water only seasonally or periodically are called vernal pools. Plant life adapted to the dynamic movement and settlement of water, which enhanced biological diversity. Since most of our school grounds are graded and flattened, water moves quickly and artificially through our environment. In this lesson, students help re-contour the land by building simple berms and swales. These human created 'valleys' and 'ridges' mimic natural soil contours to direct and slow the movement of water.

VOCAB

Berm
Swale
Percolate
Vernal Pool

PROPS

Glass of water
Eye dropper
Planting flags
Shovels

LESSON ACTIVITY

Refer to student responses from Lesson 1 (Can You Make Friends with Plants?) which likely included 'water'. Plants need water to survive; how can we enhance the soil's ability to hold water for species that prefer damp conditions, and how can we move water away from those that prefer dry conditions?

Place a drop of water in each student's palm, and ask each to keep the drop in his or her hand without allowing it to drip. See if they can move the drop of water around the surface of their hand.

Q: Where is the easiest place for you to hold the drop of water so that it will not drip out of your palm?

If the ground is relatively flat, have students create their own small berms and swales. Ask students to place their planting flags in the best areas, then draw the berms and swales that they've created.

Q: If your hand were a set of hills and valleys, would the water settle in a hill or a valley?

Q: If you move the drop to the 'hill' does it stay there?

Q: Study the shape of your hand-- how is it like the land?

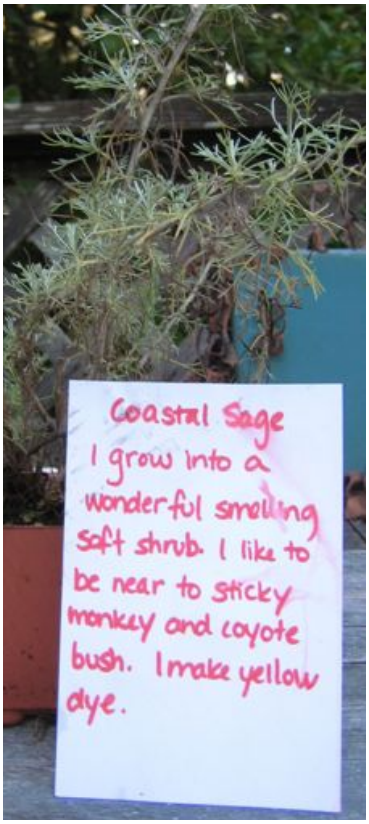
Collect student responses, then draw 'hills' and 'valleys' on the board for students to see. Have a student color in the area where the water is most likely to collect. Label the hill 'berm' and the valley 'swale'. Tell students that humans can create their own berms and swales to help move water around.

Q: How could we shape the land to help water collect at the roots of our plants?

Q: How could we shape the land to move water away from the roots of our plants?

Have students go to the planting site and observe the contours of the land in small areas (approximately 2-3 square feet, the area needed for a plant start). Have students identify good areas to plant in— lower areas benefit plants that like to have their roots wet, while higher areas benefit dry-growing species. Ask students to record these areas by drawing them in their journals and marking them with planting flags. If students are able, have them write descriptions of the planting areas they recommend.

Plant Personalities



To find useful information to create the plant personality, ask the nursery where the plant start was purchased or visit the USDA plant database.

Students have mattached the plat personality tags they received in the classroom to the plants in the field. They planted the species in their respective locations and take notes on the process.

BACKGROUND

Indigenous cultures around the world have long familiarized themselves with the useful, positive, and negative attributes of plant species. For example, poison oak was deemed the 'fire-doctor' for its ability to infect individuals with a 'fire- like' rash that it left on the skin. The personification of various species often signifies each plant's practical uses. Creating a story for each plant in your restoration garden helps students identify and learn each species' attributes

PROPS

Index Cards (make two index cards per plant species; one to be passed out in the classroom, and one to be taped to the plant start)
Plant starts

LESSON ACTIVITY

To prepare, place plant starts in the flagged areas from Lesson 4. During class, organize students into groups of 2-4, and give each group an index card with a plant personality written on it. Have one member of each group read the plant personality to the class. After students have heard all of the personalities, invite them to go outside and plant their new native plant 'friends'.

Have students draw the new planting site and write about the planting process in their restoration journals.

Preparing the Dye Vat

Students harvest from their site, giving the coyote brush a 'gentle haircut.'

Dye vat in use.

BACKGROUND

Making dyes is a wonderful way for students to see how their own tending and pruning practices can be the first step to color creation. Tending plants to make dyes is an ancient and time-honored process; synthetic dye technology became available relatively recently in1856. Synthetic color, now omnipresent, is made from the refinement of oil and coal tar, and at its root is not a sustainable process. When students take part in making color naturally, they substitute a non-renewable process with a renewable and regenerative one.

VOCAB

Botanic Color
Dye
Synthetic Color
Tend

PROPS

Enamel or stainless steel 2-4 gallon pot
Stove-top or hot plate
Scissors

LESSON ACTIVITY

It will take at least a full school year of growth until plants are mature enough to prune, but established plants in the restoration garden or on the school site can be used in the meantime. Let students know that each plant holds unique "secrets" within them. Lead students to the area where they will be harvesting. Before the students prune the plant, have them ask permission (this is Native American etiquette). When the students hear their answer (this is the quiet voice within), they may then gently prune the plant. Ask students to say, 'Thank you' when they are finished. This can be likened to a 'hair-cut.' Have students avoid areas where insects may be living. Once the plant has been harvested, put the plant matter into the pot.

Fill the pot with water and boil for one hour. Let the dye vat rest overnight, and then re-boil the next day. Your dye pot is now ready for use.

Have students take notes or draw the process of making the dye vat. Students can draw the various steps they took part in—asking permission, harvesting, putting in the dye pot, and boiling the water.

LESSON 7

Dye the Fiber

Many types of materials can be died, including silk scarves. The student below made dye vats from coyote brush (above) and toyon (below).

For mordant instructions refer to the book Harvesting Color by Rebecca Burgess.

BACKGROUND

The secrets of the plant emerge in the dye vat. Each plant has a secret color, and it is most often not the color of the plant itself. Humans likely invented the dye process due to some ancient cooking accident, where cooked plant matter ended up staining animal skins.

PROPS

2-3 gallon enamel or stainless steel pot
alum
stove or hotplate

VOCAB

Mordant- a binding agent, normally a metal ion used in the dye process

LESSON ACTIVITY

Teacher can do the following during or before the lesson. Help prepare your students' fabric or fibers of choice by mordanting them, unless you are dyeing with oak, walnut, or toyon (all of which can hold color without a mordant). To do this, fill a pot with plenty of water and add a small amount of alum (can be purchased from Dharma Trading Company, or other dye supply houses). Calculate the exact weight of alum by weighing the quantity of material to be dyed, and dissolving 10% of that amount into your mordant bath. Bring the water to a high heat (almost a boil), and add material for one hour. Remove the material after an hour and rinse before adding it to your dye vat. Cook the materials in your dye vat for one hour, or leave them in overnight. Once you've removed them, give them a good rinse and you're done.

Students can draw the steps of the dye process in their journals

Weave the Fabric

The yarns for this weaving were dyed, bottom to top, in native coyote brush, toyon, and coffeeberry.

More weaving information can be found in 'Spider Games, A Book for Beginning Weavers'.

BACKGROUND

Over centuries, cultures around the world have honed the meditative and artful practice of weaving. The small bags students will craft in this lesson can hold a myriad of treasures: small rocks, dried flowers, shells, and buttons.

PROPS

Small Cardboard pieces (suggested size: no bigger than 4x6)
Tapestry needles (weaving can be done with fingers too)
Dyed Yarn

VOCAB

Warp
Weft

LESSON ACTIVITY

-Cut the cardboard to the desired size. The bag will be woven onto this piece and will be the size and shape of the cardboard.
-Mark the cardboard with small lines every ¼"
-Cut 1/8" into those lines with your scissors
-This is your loom, which you can now warp.

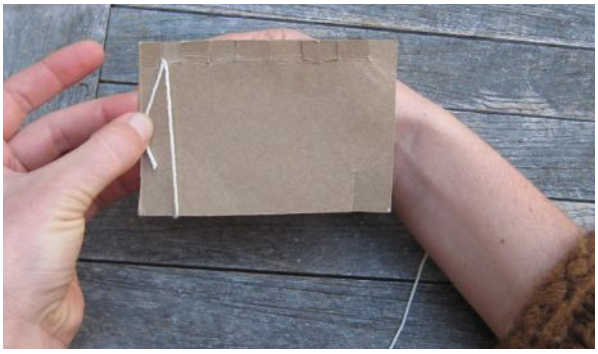
See Fig. 8 for visual aid to the following steps.

1-2) Wedge the warp thread into the first cut in the cardboard, then draw it down vertically over the front, around the bottom, and up the other side (see image). 3-4) Wedge the thread into the same first notch, then bring it across through the second notch to create a horizontal stitch on the front side of the loom. Tighten the thread both where it goes around the bottom of the cardboard and where it crosses from notch to notch, so that it lies straight, with no loose loops. 5) Draw the thread around the bottom of the cardboard, up into the front of notch two and immediately back across to notch three. Tighten as before. Continue until you have threaded all of the notches.

You will end up at the top, with an even number of warps on both sides of the loom. You need an odd number of threads for the in-and-out of the weaving to work, so cut an extra notch at the bottom corner and have your warp thread end there. Break off the warp with a few inches hanging free. You are now ready to weave.

Impress upon students that the weavings they've created and the process they've undertook is the same process for which most of their own garments were made. All of the color they've created is from the raw plant material that they have both planted and harvested. Ask students their responses to the process, and have them share these individual responses with the rest of the class. Students can also record their responses in their journals.

1



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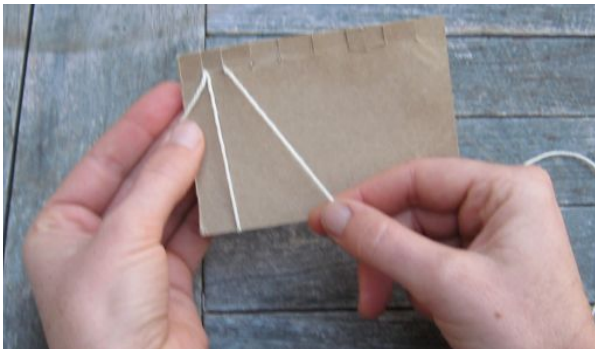

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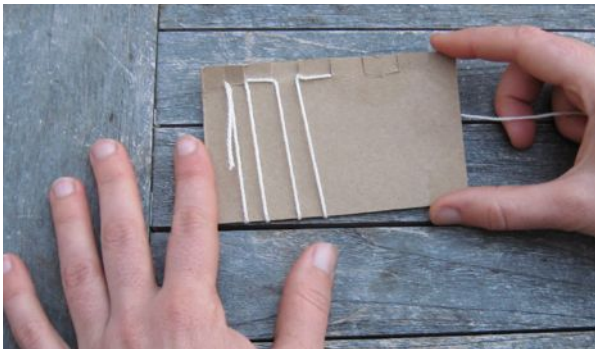

5

When you've reached the top of the weaving, pop off the white warp threads.

Further Reading

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"Harvesting Color" by Rebecca Burgess is available at your local bookseller's, or can be purchased online.