

EXPLORE CRAFTS AND MAKING · RANGER

Track 7 of the Explore Tracks at the Ranger level: four trails for young makers who are ready for more facts, diagrams, patterns and notebook entries about sewing, knitting and needlework, paper and hand crafts, and making, pricing and selling their own work.

First edition

Them hath he filled with wisdom of heart, to work all manner of work, of the engraver, and of the cunning workman, and of the embroiderer, in blue, and in purple, in scarlet, and in fine linen, and of the weaver, even of them that do any work, and of those that devise cunning work.

Exodus 35:35 (KJV)

COURSE GUIDE

Explore Tracks are for children who want more of what they love. Each track is a set of short, stand-alone stops. At the Ranger level every stop adds to the story: more facts and history, a labelled diagram or pattern, a picture to study closely, a hands-on task, a game, and a short written entry in the Field Notebook.

The Crafts track has four trails of eight stops. Trail A learns the tools and stitches of hand sewing, reads a pattern and lays it out on the grain, and finishes a lined drawstring bag before meeting the sewing machine with a parent. Trail B traces wool from fleece to yarn as the virtuous woman of Proverbs 31 knew it, knits a scarf, works the classic embroidery stitches and stitches a verse sampler of the kind children made for centuries. Trail C follows paper from papyrus to the paper mill and practises origami, calligraphy, quilling, pressed flowers, beading and a hand-sewn notebook. Trail D begins with Bezalel and Aholiab, the craftsmen God filled with wisdom of heart for the tabernacle, and ends with the child's own small product line, a costed price list and a profit sheet.

Along the way the Ranger measures and calculates yardage, compares a stitch to the Bayeux Tapestry's, works out what an hour of careful work is worth, and learns that good work done heartily is work done "as to the Lord."

WHO IT IS FOR

Written for children about ages 10–13 who read on their own and can write a paragraph. Younger brothers and sisters working at the  Scout level, and older ones at the  Expert level, can do the same stops together, each at their own depth. No sewing or knitting experience is needed, and nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 20–30 minutes: read the story, study the picture or diagram, do the hands-on part, play the game and write the notebook entry. Two or three stops a week works well. Longer projects, like the scarf, the sampler or the notebook, can keep going for a few days after the stop.
2. **Any order.** The four trails are independent, and every stop stands on its own. Within a trail, the early stops teach skills the later projects use, so going in order there makes the work easier.
3. **Field Notebook.** Each stop ends with a short entry: a stitch sample taped in and labelled, a diagram, a pattern, a table or a paragraph in the child's own words. Each trail builds something: a lined drawstring bag, a knitted scarf and cross-stitched verse sampler, a hand-bound notebook, or a small product line with its own price list and books. A parent signs each trail certificate.
4. **Goes deeper in.** Each stop names the School Launch course that covers the same ground in full: Art, Small Business & Economics, Arithmetic, History, Life Science, Gardening & Animals, Geography or Literature.

5. **Badge quizzes.** Each trail has a short, optional quiz, oral or written. They are for review and fun, not grades.

SCOPE AND SEQUENCE

Trail 1: Crafts and Making ✕ **Trail A: Sewing** (Self-paced)

Trail 2: Crafts and Making ✕ **Trail B: Knitting and Needlework** (Self-paced)

Trail 3: Crafts and Making ✕ **Trail C: Paper and Hand Crafts** (Self-paced)

Trail 4: Crafts and Making ✕ **Trail D: Make It, Price It, Sell It** (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)**One for the whole track. Stitch samples, swatches and paper crafts can be taped in.
- **A sewing kit: sharp hand needles, a needle threader, pins, a thimble, all-purpose thread, a seam ripper, fabric scissors, a tape measure, buttons, felt and cotton fabric**For Trail A and the needlework stops. Keep fabric scissors for fabric only.
- **Worsted-weight wool or wool-blend yarn, a pair of size 8 (5 mm) knitting needles, an embroidery hoop, embroidery floss and 14-count Aida cloth**For Trail B. One or two skeins of yarn make a scarf.
- **Paper (plain, colored and cardstock), a glue stick, a metal ruler, a bone folder or butter knife, a calligraphy or broad-tip marker, an awl or large needle, waxed or strong thread, quilling strips and beads with stringing wire or cord**For Trail C. Flowers for pressing can come from the yard or the garden; a heavy book makes a fine press.
- **A calculator, index cards, ruled paper for a ledger, and a small box or tin for a cash box**For Trail D.
- **A Bible (KJV)**For the verse at each stop.

GRADING

Explore Tracks are not graded. A Ranger stop is done when the child has read the story, done the hands-on part and written a notebook entry that is neat, labelled and in his or her own words.

Badges and trail certificates are earned by finishing the stops. A first seam may wander; the goal is careful, honest work that improves, not perfection.

- Every five stops earns a printable badge; finishing a trail earns a certificate.

A NOTE TO PARENTS

You do not need to sew or knit. Let the child read the story, then talk it over: “What did you learn? How would you do it better next time?” Each stop has a short *For families* note with sources and any facts that are uncertain or disputed. A grandparent or friend who sews or knits is a wonderful helper.

Safety: needles, pins, scissors, awls and craft knives are real tools. Keep a pincushion and a lidded box for sharp things, count needles in and out, cut away from the body, and keep tools away from small children and pets. An adult should be beside the child for the sewing machine stop (A8), any iron, any hot glue and any craft knife. Stops that use these say so in a safety line.

Selling: Trail D can end with a family “shop” or a real craft-fair table. Any real selling, whether to neighbors, at church, online or at a fair, needs a parent’s sign-off, and a parent handles the money, the location and any rules that apply. A family shop with play money teaches the same lessons.

Pictures are public-domain paintings, textiles and photographs, including Vermeer’s *The Lacemaker*, Velázquez’s *The Spinners*, the Bayeux Tapestry (which is really embroidery), early American samplers and William Morris’s *Strawberry Thief*. Scenes from the Bayeux Tapestry show the Norman Conquest; they are described plainly, without dwelling on the battle.

Scripture is quoted from the King James Version and read as true. Bezalel and Aholiab, the virtuous woman of Proverbs 31 and Dorcas of Joppa are real people whose handiwork served God and their neighbors, and the track presents them that way.

CONTENTS

Trail 1: Crafts and Making ✕ Trail A: Sewing

- 1.1 The Sewing Box: Needles, Pins, Thimble and Scissors
- 1.2 Threading a Needle and Tying a Knot
- 1.3 Running Stitch and Backstitch
- 1.4 Sewing On a Button
- 1.5 A Pincushion
- 1.6 A Drawstring Bag
- 1.7 Patterns and Pinning
- 1.8 Meet the Sewing Machine (with a Parent)

Trail 2: Crafts and Making ✕ Trail B: Knitting and Needlework

- 2.1 Wool: From Sheep to Yarn
- 2.2 Finger Knitting
- 2.3 Casting On and the Knit Stitch
- 2.4 A First Scarf
- 2.5 Embroidery Stitches: Stem, Chain, Satin and French Knot
- 2.6 A Sampler, As Children Stitched for Centuries
- 2.7 Cross-Stitch a Verse
- 2.8 Quilts and the Quilting Bee

Trail 3: Crafts and Making ✕ Trail C: Paper and Hand Crafts

- 3.1 Paper: From Papyrus to the Paper Mill
- 3.2 Origami: Folding Paper Precisely
- 3.3 Hand-Lettering and Calligraphy
- 3.4 Cards and Stationery
- 3.5 Paper Quilling
- 3.6 Pressed-Flower Bookmarks
- 3.7 Simple Bookbinding
- 3.8 Beading and Simple Jewelry

Trail 4: Crafts and Making ✕ Trail D: Make It, Price It, Sell It

- 4.1 Bezalel and Aholiab, the First Named Craftsmen
- 4.2 Choose a Product
- 4.3 Costing Materials and Time
- 4.4 Setting a Fair Price
- 4.5 Quality Control: Would You Buy It?
- 4.6 Labels, Packaging and a Simple Logo
- 4.7 A Craft-Fair Table or a Family “Shop”
- 4.8 Keep the Books: Sales, Costs and Profit

Trails may be done in any order.

CRAFTS AND MAKING ≈ TRAIL A: SEWING

The first trail of the Crafts and Making track teaches sewing from the first needle to the sewing machine: the tools of the sewing box and their history, threading and knotting, the running stitch and the backstitch, sewing on buttons, a stuffed pincushion, a drawstring bag, paper patterns and pinning on grain, and a first supervised session at the sewing machine. Along the way the student meets Adam Smith's pin workshop, Dorcas of Joppa, Ebenezer Butterick and the inventors Thimonnier, Howe and Singer.

This is the ● **Ranger** level, for ages 10 to 13. The student reads each stop alone and works through the story, key terms, picture study and project, then draws a labeled diagram and writes a short paragraph in the Field Notebook. A parent stays close for needles and scissors, presses with the iron, and sits beside the student for every sewing-machine session. Every stop stands by itself, but the skills build: the pincushion (Stop A5) and the drawstring bag (Stop A6) use every stitch learned before.

Five stops earn the **Sewing Ranger badge, part 1**; all eight stops earn part 2 and the **Trail A certificate**. The optional badge quizzes below may be used to review.

BEFORE YOU BEGIN

- Read a page of instructions alone and follow the steps in order.
- Measure with a ruler to the nearest 1/8 inch, and add and subtract simple fractions.

MASTERY CHECKLIST

- ☐ I can name the tools in a sewing box, use them safely and tell something of their history.
- ☐ I can thread a needle, tie a quilter's knot and tie off neatly.
- ☐ I can sew an even running stitch and a strong backstitch, and sew on a button with a thread shank.
- ☐ I can plan a project with seam allowances, read pattern symbols, and pin and cut on grain.
- ☐ I have made a pincushion and a drawstring bag, and sewn a straight line on a sewing machine with a parent.

OPTIONAL BOOKS AND RESOURCES

- **4-H Sewing and Clothing projects (your state's Cooperative Extension)** (<https://4-h.org>): Free beginner sewing guides and project sheets from many state extension offices; search your state's extension site for "4-H sewing."
- **Smithsonian National Museum of American History: sewing machine patent models** (<https://americanhistory.si.edu>): Photos of Howe's and Singer's patent models and other early machines, for Stop A8.

- **Victoria and Albert Museum: William Morris and historic pockets**
(<https://www.vam.ac.uk>): Search the collection for “Strawberry Thief” (Stop A7) and for “pocket” to see embroidered tie-on pockets from the 1700s (Stop A6).
- **Adam Smith, *The Wealth of Nations* (1776), Book I, chapter 1**
(<https://www.gutenberg.org/ebooks/3300>): The famous pin-factory passage, free at Project Gutenberg. Read the first few paragraphs with Stop A1.

1.1 THE SEWING BOX: NEEDLES, PINS, THIMBLE AND SCISSORS

OBJECTIVES

- Name the basic hand-sewing tools and tell what each one is for.
- Explain how needles, pins, thimbles and scissors were made in the past and how they are made now.
- Set up and label a sewing box, and follow the rules for keeping it safe.

Warm-up. Look at the shirt or sweater you are wearing. Turn up a hem or look inside a seam. Count how many stitches you can see in one inch. Every one of them was made with a needle, a thread and some kind of cutting tool. What tools do you think a person needs to make a stitch?

Video slot. Video coming. Basic hand-sewing tools for beginners: needles, pins, thimble, fabric scissors, tape measure, seam ripper. Search approved channels (a 4-H or county extension channel, Smithsonian, a sewing-school channel for children); preview first.

KEY TERMS

needle

A thin, pointed tool of steel with a hole called an eye at one end, used to pull thread through cloth.

pin

A short pointed wire with a head and no eye, used to hold layers of cloth together before sewing.

thimble

A small cap of metal, leather or plastic worn on the middle finger to push the needle without hurting the finger.

shears

Long scissors for cutting cloth, often with one handle bent so the blade can lie flat on the table.

seam ripper

A small tool with a sharp hook for cutting and taking out wrong stitches.

CORE IDEAS

Sewing is one of the oldest crafts in the world. The Bible tells that soon after the Fall, Adam and Eve “sewed fig leaves together” (Genesis 3:7). Archaeologists have found **needles** of bone and ivory, with tiny eyes drilled at one end, at very old sites in Europe and Asia. Later people made needles of bronze, then iron. By the 1700s the town of Redditch in England had become famous for steel needles, and by the 1800s it was making millions of them every

year. A needle is made by cutting steel wire, pressing or punching the eye, grinding the point, hardening the steel with heat and polishing it until it slides easily through cloth.

Pins look like needles without an eye. In 1776 the Scottish thinker Adam Smith used a pin workshop to teach about work in his book *The Wealth of Nations*. He wrote that making a pin was divided into about eighteen separate steps: one man drew out the wire, another straightened it, a third cut it, a fourth pointed it, and so on. Ten workers sharing the steps could make about 48,000 pins a day, while one man working alone might not make even twenty. In 1832 an American doctor, John Howe, invented a machine that made whole pins, and pins became cheap. Today the best pins for a beginner have big glass or plastic heads that are easy to see and easy to pick up.

A **thimble** protects the finger that pushes the needle. Romans used small bronze thimbles, and in the 1500s and 1600s the city of Nuremberg in Germany was famous for brass ones. The little dimples on a thimble catch the end of the needle so it does not slip. A thimble is worn on the middle finger of the hand that holds the needle. It feels strange at first, but sewers who learn to use one can push through thick cloth without sore fingers.

Cutting tools are just as old. The earliest were **shears** made from one strip of metal bent into a U, so the two blades sprang back apart after each cut. Romans made scissors with two blades joined by a pivot, the kind we still use. A sewer keeps several: long fabric shears for cutting cloth, small sharp snips for clipping threads, and sometimes pinking shears, which cut a zigzag edge that does not fray as fast. One rule is very old: fabric scissors are for fabric only. Paper dulls the blades quickly.

A good sewing box also holds a tape measure (most are 60 inches long), a **seam ripper** for taking out mistakes, spools of thread, a needle threader, a piece of tailor's chalk or a fabric marker, and a pincushion. Everything has a place. A needle dropped on the carpet can end up in a bare foot or in a dog's paw, so careful sewers count their needles and pins out of the box and count them back in. Good tools, kept clean and in order, make good work easier.

PICTURE STUDY



The Tailor (Il Tagliapanni), Giovanni Battista Moroni, c. 1565–1570 · Oil on canvas · The National Gallery, London
Wikimedia Commons · Public domain

Moroni was a portrait painter in Bergamo, in northern Italy. Most portrait painters of his day painted nobles and churchmen, but here he painted a working craftsman at his table, holding the tool of his trade. The Italian title means “the cloth-cutter.” Look closely: the black cloth has chalk lines on it, marking where the tailor will cut.

Look closely

- Find the shears. How are they different from the scissors in your house?
- Find the chalk lines on the cloth. Why would a tailor mark the cloth before cutting?
- Look at the tailor’s own clothes. What can you tell about his skill from what he wears?

Talk about it

1. Why do you think the painter showed the tailor stopping to look up, with his shears ready?
2. What does this painting tell you about how people in the 1500s thought of good craftsmen?

Safety first. Needles, pins and scissors are sharp. Carry scissors closed with the points down, and hand them to someone handle first. Never hold pins or needles in your mouth. Count needles and pins out and back in, and keep the sewing box out of reach of small children and pets.

HANDS-ON: SET UP AND LABEL YOUR SEWING BOX

Gather the tools you will use for the whole trail into one box, and make a labeled diagram of where each tool lives.

You will need

- A shoebox, tin or small plastic box with a lid
- Hand-sewing needles (a pack of “sharps” in mixed sizes) and a needle threader
- Glass-head or ball-head pins
- A thimble that fits your middle finger
- Small fabric scissors or snips (with a parent’s permission)
- A tape measure, a seam ripper, a spool of all-purpose thread, and tailor’s chalk or a fabric pencil
- A strip of felt or a scrap of wool fabric to hold needles until you make a pincushion in Stop A5

Steps

1. Empty the box and wipe it clean. Decide on a place for each tool: sharp things together in one corner, soft things in another.
2. Thread your needles through the strip of felt so they cannot roll around. Count them and write the number on a slip of paper inside the lid.
3. Try on the thimble. It should stay on when you shake your hand but not squeeze.
4. Lay out the tape measure and find the 60-inch end. Measure your hand span and your arm from shoulder to wrist.
5. Draw a top-view diagram of your open box (see the notebook task) and tape a copy inside the lid.

Check your work

- Every tool has a place in my box.
- My needle count is written inside the lid.
- I can name every tool and tell what it is for.

FIELD NOTEBOOK

1. **Diagram: My sewing box.** Draw your open box from above, as a bird would see it. Draw each tool in its place and label it: needles, pins, thimble, fabric scissors, snips, tape measure, seam ripper, thread, chalk. Draw an arrow to the sharp corner and write “Sharps.”
2. **Notebook entry.** Write a paragraph: Which tool in your box has the longest history, and what did you learn about how it was made? Use at least one date.

Did you know? Hand-sewing needles are sized by number, and the bigger the number, the thinner the needle. A size 10 sharp is much finer than a size 3. “Sharps” are medium-

long needles for everyday sewing; “betweens” are short needles for quilting; “embroidery” or “crewel” needles have long eyes for thick thread. In the 1700s, pins were costly enough that people saved “pin money” for them.

Map or diagram. On a map of Europe, find Redditch in England (needles), Nuremberg in Germany (thimbles) and Bergamo in Italy (where Moroni painted his tailor). Mark each with a small drawing of the tool.

Goes deeper in. Small Business & Economics, “Division of Labor” (Adam Smith’s pin factory), and History, “The Industrial Revolution.”

For families. Sources: Adam Smith, *The Wealth of Nations* (1776), Book I, chapter 1 (the pin workshop, about eighteen operations, about 48,000 pins a day for ten workers); The National Gallery, London, on Moroni’s *The Tailor* (1565–70). The dates of the oldest eyed needles keep changing as new finds are made, so the stop says only “very old sites.” John Ireland Howe’s pin machine was patented in the 1830s. For younger siblings, small blunt-tipped scissors and large-eye tapestry needles are a safe start.

PRACTICE

1. **EASY** What is the difference between a needle and a pin?
2. **EASY** On which finger is a thimble worn, and why?
3. **MEDIUM** Why should fabric scissors never be used to cut paper?
4. **MEDIUM** Adam Smith said ten workers could make about 48,000 pins a day. About how many pins is that for each worker?
5. **CHALLENGE** One worker alone might make 20 pins a day. How many times more pins does each worker make when the work is shared out, as in Adam Smith’s workshop? Why does dividing the work help so much?

Make it a game · Sewing Box Memory. Lay all the tools on a tray. Study them for 30 seconds, then cover the tray with a towel. A parent takes one tool away in secret. Uncover the tray: name the missing tool and say what it is for. Take turns being the one who hides a tool. (Keep sharp tools on the tray; no one carries them.)

Scripture. “Them hath he filled with wisdom of heart, to work all manner of work, of the engraver, and of the cunning workman, and of the embroiderer, in blue, and in purple, in scarlet, and in fine linen, and of the weaver, even of them that do any work, and of those that devise cunning work.” (Exodus 35:35, KJV)

When Israel built the tabernacle, God gave skill to the craftsmen and to the embroiderers and weavers. Skill with a needle is a gift from God, and learning to use good tools well is a way of honoring Him.

Practice: answers

1. A needle has an eye to carry thread through cloth; a pin has a head and no eye and is used to hold cloth in place.
2. On the middle finger of the hand holding the needle, because that finger pushes the needle through the cloth.
3. Paper dulls the blades, and dull scissors chew and fray cloth instead of cutting it cleanly.
4. About 4,800 pins each ($48,000 \div 10$).
5. $4,800 \div 20 = 240$ times more. Each worker repeats one step, grows fast and skilled at it, and does not lose time changing from tool to tool.

1.2 THREADING A NEEDLE AND TYING A KNOT

OBJECTIVES

- Cut a thread to the right length and thread a needle, with and without a needle threader.
- Tie a starting knot (the quilter's knot) and a finishing knot.
- Explain what thread is made of and why a thread's length and doubling matter.

Warm-up. Hold a piece of thread up to the light and look at the end through a magnifying glass if you have one. Is it one strand, or several twisted together? Now try to push it through a buttonhole without twisting it first. What happens to the end?

Video slot. Video coming. How to thread a needle and tie a quilter's knot; how to tie off at the end of a seam. Search approved channels (a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

eye

The hole at the blunt end of a needle that the thread goes through.

ply

One of the strands twisted together to make a thread or yarn. Most sewing thread is two-ply or three-ply.

needle threader

A little tool with a thin wire loop that goes through the eye, catches the thread and pulls it back through.

quilter's knot

A neat starting knot made by wrapping the thread around the needle and sliding the wraps down to the end.

tie off

To finish a line of stitches with a knot close to the cloth so the stitches cannot pull out.

CORE IDEAS

Thread is made the same way rope is made, only very small. Fibers of cotton, linen, silk or polyester are spun into fine strands, and two or three strands, called **plies**, are twisted together so they hold one another. In the 1700s most sewing in Britain was done with linen or silk thread. In the early 1800s mills in Paisley, Scotland, began twisting strong, smooth cotton thread and winding it on wooden spools. Paisley thread was shipped all over the world, and families who once spun their own thread at home could buy a spool at the store. Today most all-purpose thread is polyester, or polyester wrapped in cotton, because it is strong and stretches a little.

The first step is cutting the right length. A good rule is about 18 to 24 inches, or from your fingertips to your elbow and a bit more. Sewers have an old saying: “a long thread is a lazy thread,” because a too-long thread tangles, knots and wears thin from being pulled through the cloth again and again. Cut the end at a slant with sharp scissors. A slanted end is narrower than a square one, and a clean cut does not fray.

To thread the needle, hold it still with the **eye** against a light background. Pinch the thread so only a tiny bit shows, and bring the needle onto the thread rather than pushing a floppy thread at the needle. Some sewers moisten the end to make it stiff. If the eye is very small, use a **needle threader**: push its wire loop through the eye, poke the thread through the loop, and pull the loop back out. Many people thread a fine needle more easily in good daylight; before electric lights, sewers worked near a window by day or close beside a candle or oil lamp at night.

Next decide: single thread or double? For most sewing, pull a tail of about 4 inches through and sew with one strand; you can pull the needle along the thread to fix mistakes. For buttons and things that must be very strong, pull the ends even and knot them together so you sew with two strands. Then tie a starting knot. The **quilter’s knot** is neat and sure: hold the needle point up, lay the thread end along it, wrap the thread around the needle three times, pinch the wraps, and pull the needle up through your fingers. The wraps slide down the thread and make a small, firm knot at the end.

At the end of your stitching, you must **tie off**. On the back of the cloth, take a tiny stitch, but do not pull it tight; pass the needle through the loop it makes, and pull. Do this twice. Leave a short tail of about a quarter inch and snip. A knot that is too far from the cloth lets the last stitch go loose; a knot that is snug against the cloth keeps every stitch in place. These small habits, practiced well now, will make every later project on this trail go faster.

PICTURE STUDY



Woman Sewing by Lamplight, Jean-François Millet, 1870-1872 · Oil on canvas · The Frick Collection, New York

Wikimedia Commons · Public domain

Millet was a French painter who lived in the village of Barbizon and painted the farm families around him. In 1872 he wrote to a friend that it was nine o'clock at night and everyone around him was at work, "sewing, and darning stockings," while he watched the lamplight fall on the cloth and balls of yarn. The sewers at his table were his wife and grown daughters.

Look closely

- Find the lamp. Which parts of the picture are brightest?
- Find the hands. What are they doing with the needle and cloth?
- Find the darkest corner. What does the darkness tell you about the hour?

Talk about it

1. Why would threading a needle be harder by lamplight than by day? What would you do to make it easier?
2. Why do you think Millet painted ordinary evening work instead of a grand event?

Safety first. Keep the needle pointed away from your face and body when threading. Never put a needle or pin in your mouth. Use sharp scissors only for cutting thread, and put the needle back in the felt strip or pincushion whenever you stop.

HANDS-ON: THE KNOT CARD

Make a practice card that shows each step of threading, knotting and tying off, with real thread taped or stitched onto it.

You will need

- A piece of felt or a scrap of plain cotton, about 6 by 8 inches
- A large-eye needle (size 3–5 sharp or an embroidery needle) and a finer needle (size 9–10)
- A needle threader
- Two colors of thread
- A ruler, scissors, tape and an index card

Steps

1. Measure and cut a thread from your fingertips to just past your elbow. Measure it with the ruler and write the length on the card.
2. Thread the large-eye needle by hand. Time yourself. Then thread the fine needle, first by hand and then with the threader. Write down which was faster.
3. Tie a quilter's knot with three wraps. Tape a sample knot to your card and label it.
4. Sew six straight stitches across the felt, then tie off on the back twice. Snip, leaving a quarter-inch tail.
5. Thread a second needle with a double strand in the second color. Tie the ends together with a quilter's knot, sew six stitches and tie off. Compare the two lines of stitches.

Check your work

- My thread was the right length and cut at a slant.
- My starting knot is small and does not pull through the cloth.
- My tie-off knot sits snug against the cloth.

FIELD NOTEBOOK

1. **Diagram: The quilter's knot in four steps.** Draw four small boxes in a row. In each, draw the needle and thread at one step: (1) thread end laid along the needle, (2) three wraps around the needle, (3) fingers pinching the wraps as the needle is pulled up, (4) the finished knot at the end of the thread. Label the needle, the eye, the wraps and the knot.
2. **Notebook entry.** Write a paragraph explaining to a younger child how to thread a needle and tie a knot. Use the words first, next, then and last.

Did you know? Thread is sold by weight numbers: the higher the number, the finer the thread. All-purpose sewing thread is usually about size 50. Before the 1800s, many sewing threads were linen; cotton thread became common after the Paisley mills began

winding it on spools. Spools were once returned to the store for a small refund and reused.

Map or diagram. Find Paisley, a town just west of Glasgow in Scotland, on a map. Draw a line from Scotland across the Atlantic to the United States to show how spools of thread were shipped to American stores.

Goes deeper in. Life Science, “Plants We Use” (cotton and flax fibers), and History, “The Industrial Revolution” (spinning mills).

For families. Sources: The Frick Collection catalog entry for Millet’s *Woman Sewing by Lamplight* (1870–72), which quotes his letter of November 6, 1872. The Paisley thread history (Clark and Coats families, early 1800s) is given in general terms; dates of particular firms vary in the sources. Left-handed sewers can do every step as a mirror image. If threading is frustrating, a self-threading or large-eye needle is a fine way to start.

PRACTICE

1. **EASY** About how long should a sewing thread be?
2. **EASY** Why do you cut the end of the thread at a slant?
3. **MEDIUM** When would you sew with a double thread instead of a single thread?
4. **MEDIUM** What does “a long thread is a lazy thread” mean?
5. **CHALLENGE** You need to sew a seam 30 inches long, and each 20-inch thread sews about 8 inches of seam. How many threads will you need to cut? Explain.

Make it a game • Thread the Needle Relay. Each player has a large-eye needle and a cut thread. On “go,” thread the needle, tie a quilter’s knot and hold it up. Then try again with a finer needle. Keep a score sheet of times. The goal is to beat your own time, not someone else’s. Needles go straight back in the felt after each round.

Scripture. “Whatsoever thy hand findeth to do, do it with thy might; for there is no work, nor device, nor knowledge, nor wisdom, in the grave, whither thou goest.” (Ecclesiastes 9:10, KJV)

Even a small job like threading a needle is worth doing well. Solomon reminds us that our days of work are a gift and are not endless, so we should work with all our strength while we have them.

Practice: answers

1. About 18 to 24 inches, roughly from fingertips to elbow and a little more.
2. A slanted end is narrower, so it goes through the eye more easily, and a clean cut does not fray.
3. When the stitches must be very strong, such as sewing on a button.

4. A thread that is too long tangles and knots and wears thin from being pulled through the cloth many times, so it wastes time instead of saving it.
5. Four threads. $30 \div 8 = 3.75$, so three threads sew only 24 inches and a fourth is needed for the last 6 inches.

1.3 RUNNING STITCH AND BACKSTITCH

OBJECTIVES

- Sew an even running stitch and a strong backstitch along a straight line.
- Explain why the backstitch is stronger than the running stitch, and when to use each.
- Measure stitch length and seam allowance in fractions of an inch.

Warm-up. Find a seam on an old pillowcase or shirt and gently pull the two sides apart. Do the stitches show? Do they look the same on both sides? Before the 1850s, almost every seam in every garment in the world was sewn by hand.

Video slot. Video coming. How to sew a running stitch and a backstitch by hand; even stitch length; sewing a straight seam. Search approved channels (a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

running stitch

The simplest stitch: the needle goes down and up through the cloth in an even dashed line.

backstitch

A strong stitch in which each stitch goes back to meet the one before, making a solid line on the front.

seam

The line where two pieces of cloth are sewn together.

seam allowance

The strip of cloth between the stitching and the cut edge, often 1/4 inch or 5/8 inch wide.

baste

To sew long, loose running stitches that hold cloth in place for a while and are taken out later.

CORE IDEAS

Until the sewing machine came into homes in the second half of the 1800s, every shirt, dress, sheet, sail and flag was sewn one stitch at a time by hand. A careful sewer might make several thousand stitches to finish one shirt. Two simple stitches did much of that work: the **running stitch** and the **backstitch**. Learn these two well, and you can mend a tear, sew a pillow, make a bag or even sew a whole garment.

The running stitch is just what its name says: the needle runs in and out of the cloth along a line. Push the needle down, bring it up a little farther on, and repeat. Good sewers load several stitches onto the needle at once by rocking the point in and out before pulling the thread through. A running stitch is fast, and it gathers easily if you pull the thread, so it is

used for **basting**, for gathering a ruffle, and for quilting. But it has gaps, and a seam sewn with it can pull apart if it is strained.

The backstitch fills those gaps. Bring the needle up from the back. Take it down one stitch length *behind* where it came up, then bring it up one stitch length *ahead*. Each new stitch reaches back to touch the last one. On the front you see a solid line that looks like machine stitching; on the back the thread overlaps, twice as long as each stitch. Because every bit of the line is covered and the thread loops back on itself, the backstitch is the strongest of the common hand stitches. Tailors and sailmakers used it for seams that had to hold.

Even stitches matter as much as the kind of stitch. For a seam, aim for stitches about 1/8 inch long, or eight stitches to the inch. Keep a steady **seam allowance**, the space between your line and the cut edge: 1/4 inch is common for small crafts and quilts, and 5/8 inch is the standard on most paper dressmaking patterns. Draw your line first with chalk or a ruler and pencil, and follow it. Pull each stitch snug, but not so tight that the cloth puckers.

In the 1700s and 1800s, girls and boys learned stitches young, and many girls stitched practice pieces to show what they could do. Ship's boys learned to sew canvas, and soldiers carried a small sewing kit, sometimes called a "housewife" or "hussif," to mend their own uniforms. Today hand stitches are still used for mending, for finishing what a machine cannot reach, and for fine work. A neat backstitch is a skill you will use all your life.

PICTURE STUDY



The Diligent Mother, Jean-Baptiste-Siméon Chardin, 1740 · Oil on canvas · Musée du Louvre, Paris
Wikimedia Commons · CC BY-SA 4.0

Chardin painted quiet scenes of French family life. This painting was shown at the Paris Salon of 1740, and Chardin gave it to King Louis XV. A young mother is checking her daughter's needlework, pointing out what is good and what must be done again.

Look closely

- Find the needlework in the mother's hands. What is she looking at so closely?
- Look at the girl's face. How do you think she feels about having her work checked?
- Find other sewing or work things in the room.

Talk about it

1. Why is it helpful to have someone check your stitches?
2. What would you say to a younger child whose stitches were uneven, to help without discouraging?

Safety first. Keep your free hand behind or beside the line of stitching, never under the place where the needle comes up. Use a thimble if the needle is hard to push. Put the needle in the felt strip whenever you stop.

HANDS-ON: THE STITCH SAMPLER STRIP

Sew a practice strip with rows of running stitch and backstitch, measure your stitches, and test which seam is stronger.

You will need

- Two strips of plain cotton, each about 3 by 10 inches, and one strip of felt 4 by 10 inches
- Needle, thread in a color that shows, thimble and scissors
- A ruler and chalk or a fabric pencil
- Pins

Steps

1. On the felt, draw three lines 1 inch apart with chalk. Sew row 1 in running stitch, aiming for 1/8-inch stitches and 1/8-inch gaps.
2. Sew row 2 in backstitch. Sew row 3 in running stitch with stitches 1/4 inch long, as if basting.
3. Count your stitches in one inch of each row and write the numbers on a paper tag pinned beside the row.
4. Now the test: pin the two cotton strips together, edges even. Draw a line 1/4 inch from one long edge. Sew half the line in running stitch and the other half in backstitch.
5. Open the strips and pull gently on each half of the seam. Which half gaps open? Which holds?

Check your work

- My stitches are close to even in length.
- My backstitch makes a solid line on the front.
- I tested both seams and can say which is stronger and why.

FIELD NOTEBOOK

1. **Diagram: Front and back.** Draw two long rectangles stacked. Label the top one "FRONT" and the bottom one "BACK." In each, draw a row of running stitch and a row of backstitch as they really look on that side. Add arrows showing which way the needle travels, and label: stitch length (1/8 inch), gap, overlap, seam allowance (1/4 inch).
2. **Notebook entry.** Write a paragraph comparing the two stitches: how each is made, which is faster, which is stronger, and one job for each.

Did you know? Some machine stitches imitate hand stitches. A sewing machine's straight stitch looks almost exactly like a backstitch on the front, but it is made a different way, with two threads that lock in the middle of the cloth. Old samplers and household linens sometimes show stitches as small as twenty to the inch.

Goes deeper in. Arithmetic, "Fractions on the Ruler" (eighths and quarters of an inch), and History, "Home Life in Colonial America."

For families. Sources: Musée du Louvre on Chardin's *La Mère laborieuse* (Salon of 1740). Estimates of how long it took to sew a shirt by hand in the 1800s vary (often given as 10 to 15 hours), so the stop gives no exact figure. The soldier's "housewife" sewing kit is well documented in the American Civil War and the British Army. Felt is easiest for practice because it does not fray.

PRACTICE

1. **EASY** Which stitch makes a dashed line with gaps on the front?
2. **EASY** What is basting?
3. **MEDIUM** Why is the backstitch stronger than the running stitch?
4. **MEDIUM** If your stitches are 1/8 inch long, how many stitches will you make in 3 inches of backstitch?
5. **CHALLENGE** In backstitch, the thread on the back is about twice the length of each front stitch. About how much thread is used in 4 inches of backstitch, counting both front and back? (Ignore the knots.)

Make it a game · Stitch Detective. A parent sews a few short lines on a scrap: some running stitch, some backstitch, some with uneven stitches. Turn the scrap over so only the back shows. Can you tell which line is which just from the back? Score one point for each right answer, then switch roles.

Scripture. "And whatsoever ye do, do it heartily, as to the Lord, and not unto men;" (Colossians 3:23, KJV)

Paul wrote this to Christian workers who served others all day. A hidden seam inside a bag may never be seen by anyone, but it is seen by the Lord. We sew even stitches heartily, as for

Him.

Practice: answers

1. The running stitch.
2. Sewing long, loose running stitches to hold cloth in place for a while; they are taken out later.
3. Every part of the line is covered with no gaps, and each stitch loops back and overlaps on the back, so there is more thread holding the seam.
4. 24 stitches (8 per inch $\times$ 3 inches).
5. About 12 inches: 4 inches on the front plus about 8 inches on the back.

1.4 SEWING ON A BUTTON

OBJECTIVES

- Sew a two-hole and a four-hole button firmly, with a thread shank.
- Tell sew-through buttons from shank buttons, and say what buttons have been made of in history.
- Explain why buttonholes changed clothing in the Middle Ages.

Warm-up. Open your family’s button jar or look at the buttons on a coat. Sort them into groups: two holes, four holes, and buttons with a loop on the back. Which kind do you find most? Which kind is on the coat, and why might that be?

Video slot. Video coming. How to sew on a two-hole and four-hole button by hand, with a thread shank. Search approved channels (a 4-H or county extension channel, Smithsonian, a sewing-school channel for children); preview first.

KEY TERMS

sew-through button

A flat button with two or four holes through it for the thread.

shank button

A button with a small loop or stem on the back, so the thread does not show on the front.

thread shank

A short stem of wrapped thread under a sew-through button that leaves room for the cloth of the buttonhole.

buttonhole

A slit in cloth, finished with tight stitches, that a button passes through.

mend

To repair clothing or cloth so it can be used again.

CORE IDEAS

Buttons are very old, but for a long time they were mostly decorations, sewn on like jewels. Ancient people fastened clothes with pins, brooches, belts and ties. In Europe in the 1200s, tailors began cutting **buttonholes** and sewing buttons opposite them. This simple idea changed clothing. A garment could now fit closely to the body and still be opened and closed many times a day. By the 1300s, rich men and women wore sleeves and coats with long rows of tiny buttons from wrist to elbow.

Buttons have been made of almost everything: bone, horn, wood, brass, silver, glass, pewter and shell. In the late 1800s, the town of Muscatine, Iowa, on the Mississippi River became known as the “Pearl Button Capital of the World,” because factories there cut buttons from

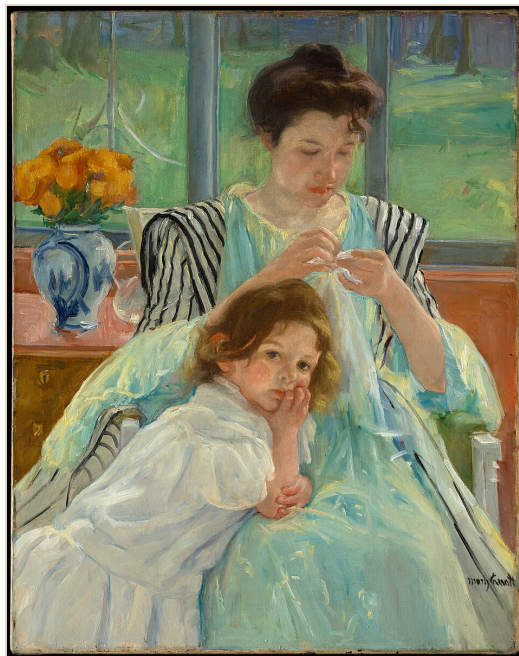
the shells of freshwater mussels. Workers drilled round blanks out of the shells with hollow saws, and the leftover shells with round holes can still be found along the riverbanks. Later most buttons were made of plastic.

There are two main kinds. A **sew-through button** is flat, with two or four holes. A **shank button** has a little loop on the back. Coats often use shank buttons, because the shank lifts the button above thick cloth. A sew-through button needs a **thread shank** that you make yourself. Without it, the button lies flat and tight against the cloth, and when you button it, the buttonhole cloth is squeezed and the threads soon wear through.

Here is the method. Mark the spot with chalk. Use a double thread about 24 inches long, knotted at the end. Come up from the back at the mark and through one hole. Lay a toothpick or a pin across the top of the button, and sew over it, down through the second hole. Go up and down five or six times. (For a four-hole button, sew two parallel bars or an X.) Remove the toothpick, lift the button, and wrap the thread around the stitches under the button three or four times to make the shank. Push the needle to the back and tie off with two or three small stitches.

In most homes, before ready-made clothing was cheap, clothes were **mended** again and again. A missing button was not a reason to throw a shirt away. Mothers and fathers kept a jar of buttons cut from worn-out clothes, and children learned to sew one back on as soon as they could hold a needle. Knowing how to sew on a button means you can care for your own things, and for others', and not waste what God has given.

PICTURE STUDY



Young Mother Sewing, Mary Cassatt, 1900 · Oil on canvas · The Metropolitan Museum of Art, New York
Wikimedia Commons · CC0

Mary Cassatt was an American painter from Pennsylvania who lived most of her life in France and painted with the Impressionists. She painted many quiet pictures of mothers and children at home. Here a mother is busy with her needle while her little girl leans on her lap.

Look closely

- Find the mother's hands. Is she sewing new cloth or mending something?
- Look at the girl. Where is she looking? How does that make you feel as you look at the picture?
- Find the window. How does Cassatt show daylight with quick brushstrokes?

Talk about it

1. Why would a mother in 1900 have so much mending to do?
2. What might the girl be learning just by leaning there and watching?

Safety first. Hold the button down with your thumb at the edge, away from the holes, so the needle does not stab your finger as it comes up. Use a thimble to push the needle through thick cloth. Put toothpicks and pins away when you finish.

HANDS-ON: THE BUTTON PRACTICE CARD AND A REAL REPAIR

Practice three ways of sewing on buttons, then find a real garment in your house that needs a button and fix it (with a parent's say-so).

You will need

- A square of sturdy cloth or felt, about 6 by 6 inches
- One two-hole button, one four-hole button and one shank button
- Needle, thread that matches or contrasts, thimble and scissors
- A toothpick
- Chalk or a fabric pencil
- A garment with a loose or missing button (optional)

Steps

1. Mark three spots on the square with chalk, 2 inches apart.
2. Sew the two-hole button over a toothpick with five or six passes, then wrap a thread shank and tie off.
3. Sew the four-hole button with two parallel bars. Make a shank the same way.
4. Sew the shank button with five or six passes through its loop. No toothpick is needed. Why not?
5. Test each button by pulling gently. Then, if a parent agrees, sew a real button back on a family garment, lining it up with its buttonhole first.

Check your work

- My buttons sit a little above the cloth, not squeezed flat.
- Each button holds when I pull it gently.
- My knots are on the back and cannot be seen from the front.

FIELD NOTEBOOK

1. **Diagram: A button in cross-section.** Draw the button as if cut in half and seen from the side. Show the cloth as a thick line, the button above it, the thread going through the holes, and the thread shank wrapped between the button and the cloth. Label: button, holes, shank, cloth, knot, front, back. Draw a second picture of the same button with the buttonhole cloth slipped under it, to show why the shank is needed.
2. **Notebook entry.** Write a paragraph about a garment you mended or a button you sewed. What was hard? What did you do to make it strong?

Did you know? Buttons on men’s clothing are usually on the right side and on women’s on the left. No one knows for certain why; there are several old explanations, and none is proved. The word “button” comes from an Old French word meaning a bud or a knob.

Map or diagram. Find Muscatine, Iowa, on a map of the Mississippi River. Trace the river from Minnesota to the Gulf of Mexico and mark Muscatine with a small button.

Goes deeper in. History, “Life in the Middle Ages” (medieval clothing), and Life Science, “Mollusks” (freshwater mussels).

For families. Sources: The Metropolitan Museum of Art on Cassatt’s *Young Mother Sewing* (1900, H. O. Havemeyer Collection); the Muscatine History and Industry Center on the pearl-button industry (late 1800s to mid-1900s). The arrival of buttonholes in the 1200s is the usual account in costume histories; dates vary by region. The story of why men’s and women’s buttons sit on opposite sides is uncertain, so we do not pick an answer.

PRACTICE

1. **EASY** Name the two main kinds of buttons.
2. **EASY** Why do you use a double thread to sew on a button?
3. **MEDIUM** What does a thread shank do?
4. **MEDIUM** Why did buttonholes change clothing in the Middle Ages?
5. **CHALLENGE** A shirt has 7 buttons. You make 6 passes through each button with a double thread. How many strands of thread hold the buttons on the whole shirt? Show your work.

Make it a game • Button Sort Race. Mix a handful of buttons in a bowl. Set a timer for one minute. Sort them into piles: two-hole, four-hole and shank. Then sort again by

material: plastic, metal, wood, shell or glass. Each correct pile earns a point. Put the buttons back in the jar so none are left for a little child to find.

Scripture. “A time to rend, and a time to sew; a time to keep silence, and a time to speak;” (Ecclesiastes 3:7, KJV)

In the Bible, to “rend” is to tear. Things wear out and tear, and there is also a time to sew them up again. Mending is good, patient work that cares for what we have.

Practice: answers

1. Sew-through buttons (with two or four holes) and shank buttons (with a loop on the back).
2. A button is pulled hard every time it is buttoned, so it needs the extra strength of two strands.
3. It raises the button a little above the cloth, leaving room for the buttonhole cloth, so the threads do not wear through.
4. Clothes could fit closely and still be opened and closed easily many times, instead of being pinned, tied or laced.
5. $6 \text{ passes} \times 2 \text{ strands} = 12 \text{ strands per button}$; $12 \times 7 \text{ buttons} = 84 \text{ strands}$.

1.5 A PINCUSHION

OBJECTIVES

- Sew a stuffed square pincushion with a backstitched seam, turned right side out.
- Close an opening with a neat whipstitch.
- Calculate the finished size of a project from the cut size and the seam allowance.

Warm-up. Look at the pins and needles in your sewing box. Where have you been keeping them? Imagine sewing for a whole day with forty pins. Where would you put each pin as you pulled it out, so you never lost one?

Video slot. Video coming. How to sew a simple square pincushion by hand; turning and stuffing; closing with a whipstitch or ladder stitch. Search approved channels (a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

pincushion

A small stuffed pad that holds pins and needles safely while you sew.

right side

The front of the fabric, the side meant to show. The other side is the wrong side.

turning gap

An opening left in a seam so the work can be turned right side out and stuffed.

whipstitch

A stitch that loops over the edge of the cloth, used to close openings and join edges.

emery

A hard, gritty natural mineral powder used to sharpen and polish metal.

CORE IDEAS

Before pins were cheap, losing one was like losing a coin. In the 1500s and 1600s, pins were made one by one, and a household might keep its pins in a little case or a cushion stuck on a stand. Ladies hung small pincushions from their belts on ribbons, beside scissors and keys, so the pins were always at hand. Some pincushions were works of art, with designs or words pricked into them in pins, and they were given as gifts at the birth of a baby or at a wedding.

Many families today have a red pincushion shaped like a tomato with a little strawberry tied to it. The strawberry is not just a decoration. It is filled with **emery**, a gritty mineral powder. Pushing a needle in and out of the strawberry a few times cleans off rust and sharpens the point. Tomato pincushions became popular in the 1800s; an old saying held that a tomato in the house brought good fortune, but that is only a story. What is true is that a good pincushion keeps your tools in order.

Your pincushion is your first finished object on this trail, and it uses every skill so far. You cut two squares, place them **right sides** together (fronts facing in), pin, and backstitch around the edges with a 1/4-inch seam allowance, leaving a **turning gap** on one side. Then you clip the corners, turn the cushion right side out through the gap, and push the corners out with a blunt pencil. The seams are now hidden inside. This is how most sewn things are made: sewn inside out, then turned.

Think about size before you cut. If you cut two squares 5 inches on a side and sew a 1/4-inch seam all around, each side loses 1/4 inch at both ends, or 1/2 inch in all. The finished cushion is 4 1/2 inches square. Sewers do this kind of arithmetic all the time. Stuffing makes the cushion puff up, so it will look a little smaller. Stuff it firmly, so pins stand up straight; a soft cushion lets pins lie over and fall out. Fiberfill, wool roving or clean wool scraps all work. Wool is the old favorite, because its natural oils help keep pins from rusting.

Last, close the gap with a **whipstitch**. Fold the raw edges of the gap inside, line up the folds, and sew tiny stitches over the edge, catching both folds each time. Small, close stitches make a neat edge. When you finish, move all your pins and needles from the felt strip into your new cushion. Count them. From now on, every pin you pull out of your sewing goes straight into the cushion, never onto the table or the floor.

PICTURE STUDY



The Lacemaker, Johannes Vermeer, c. 1669–1670 · Oil on canvas, mounted on panel · Musée du Louvre, Paris

Wikimedia Commons · CC BY-SA 3.0

Vermeer lived in Delft in the Netherlands and painted very few pictures, perhaps fewer than forty that survive. *The Lacemaker* is one of the smallest, only about 9 1/2 by 8 1/4 inches. She is making bobbin lace on a firm stuffed pillow, sticking pins into it to hold each thread in place, much as you will stick pins into your cushion.

Look closely

- Find the lace pillow and the tiny pins in it. Why must the pillow be firm?
- Find the sewing cushion in front, with red and white threads spilling out. Why do you think Vermeer painted the threads blurry?
- Look at the lacemaker's hands and eyes. How does the painter show that she is concentrating?

Talk about it

1. Why would a lacemaker need hundreds of pins, and how would she keep them in order?
2. Vermeer painted this picture very small. How does its size fit what it shows?

Safety first. When you count your pins into the new cushion, do it over a table, not your lap. Stuff the cushion with a blunt pencil or chopstick, not scissors. Keep the finished pincushion high, out of reach of toddlers and pets.

HANDS-ON: SEW A SQUARE PINCUSHION

Make a firm 4 1/2-inch pincushion that will hold your pins and needles for the rest of the trail.

You will need

- Two squares of sturdy cotton, felt or wool fabric, each 5 by 5 inches
- Needle, thread, pins, thimble and scissors
- A ruler and chalk
- Stuffing: fiberfill, wool roving or clean wool scraps (about a large handful)
- A blunt pencil or chopstick for turning and stuffing
- Optional: a button for the center, or a felt strawberry filled with a spoonful of emery or fine clean sand

Steps

1. Measure and cut two 5-inch squares. On the wrong side of one, draw a line 1/4 inch in from every edge with chalk.
2. Place the squares right sides together. Pin at the corners and in the middle of each side, with pins at right angles to the edge.
3. Backstitch along the chalk line all around, leaving a 2-inch turning gap in the middle of one side. Take out pins as you come to them and put them back in your felt strip.
4. Snip off each corner close to the stitching, but do not cut the thread. Turn right side out and push the corners out gently.
5. Stuff firmly, filling the corners first. Fold in the edges of the gap and close it with tiny whipstitches. Tie off and hide the tail inside the cushion.

6. Optional: sew a button through the center from top to bottom and pull tight to make a dimple.

Check your work

- My cushion is firm, and a pin stands up straight in it.
- The corners are pushed out and the seams are hidden inside.
- My whipstitches are small and the gap is closed.

FIELD NOTEBOOK

1. **Diagram: Pincushion plan.** Draw one 5-inch square to scale (use a ruler, 1 inch = 1 inch). Draw a dashed line $\frac{1}{4}$ inch inside the edges and label it “stitching line.” Shade the $\frac{1}{4}$ -inch strip and label it “seam allowance.” Mark the 2-inch turning gap with two small lines and an arrow, and draw small triangles at the corners labeled “clip.” Write the finished size, 4 $\frac{1}{2}$ inches, beside it.
2. **Notebook entry.** Write a paragraph telling how you made your pincushion, step by step, and one thing you would do differently next time.

Did you know? Wool is often used to stuff pincushions because the lanolin, a natural oil in sheep’s wool, helps protect steel pins from rust. Emery, the grit inside the strawberry, is a dark rock made of the mineral corundum mixed with iron minerals such as magnetite. Corundum is the same mineral that makes rubies and sapphires.

Goes deeper in. Arithmetic, “Perimeter and Area” (finished size and seam allowance), and Earth Science, “Rocks and Minerals” (emery and corundum).

For families. Sources: Musée du Louvre on Vermeer’s *The Lacemaker* (c. 1669–1670, about 24 by 21 cm). The tomato-on-the-mantel saying is folklore; the stop says so. Emery is sold in small packets in fabric stores; fine clean sand works as a substitute but does not sharpen as well. If wool stuffing is used, make sure it is clean and dry. Square size can be 4 or 6 inches; the arithmetic changes in the same way.

PRACTICE

1. **EASY** Why do you sew the pincushion with the right sides together?
2. **EASY** What is the little strawberry on a tomato pincushion for?
3. **MEDIUM** Why should a pincushion be stuffed firmly?
4. **MEDIUM** You cut two 6-inch squares and sew a $\frac{1}{4}$ -inch seam all around. What is the finished size?
5. **CHALLENGE** You want a finished pincushion 4 inches square with a $\frac{1}{2}$ -inch seam allowance. How big must you cut each square? What is the area of the finished top in square inches?

Make it a game · Pin Count Challenge. A parent drops ten pins onto a dark towel spread on the table. Using a magnet or your fingers, find and put every pin into your pincushion before the timer runs out (try 60 seconds). Count them in. Then hide five pins in a fold of the towel and see who can find them. This is the real habit every sewer needs: no lost pins.

Scripture. “Let all things be done decently and in order.” (1 Corinthians 14:40, KJV)

Paul wrote this about worship in the church at Corinth, but the rule fits every kind of good work. A pincushion is a small way of keeping things in order, so that work is safe and nothing is lost.

Practice: answers

1. So that when it is turned right side out, the seams and raw edges are hidden inside.
2. It is filled with emery, which cleans and sharpens needles when you push them in and out.
3. So pins stand up straight and stay in; in a soft cushion pins lean over and fall out.
4. 5 1/2 inches square ($6 - 1/4 - 1/4$).
5. Cut 5-inch squares ($4 + 1/2 + 1/2$). The finished top is $4 \times 4 = 16$ square inches.

1.6 A DRAWSTRING BAG

OBJECTIVES

- Sew an unlined drawstring bag with backstitched side seams and a casing.
- Plan the cut size, finished size and cord length with arithmetic before cutting.
- Tell how drawstring purses, tie-on pockets and reticules were used in history.

Warm-up. Empty your pockets, or look at what a family member carries in a pocket or purse. Before clothes had sewn-in pockets, where do you think people kept their coins, keys and needles?

Video slot. Video coming. How to sew a simple drawstring bag by hand or for beginners; making a casing and threading a cord with a safety pin. Search approved channels (a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

casing

A folded and stitched tunnel of cloth that holds a drawstring or elastic.

drawstring

A cord threaded through a casing that pulls an opening closed.

raw edge

A cut edge of fabric that has not been folded or finished and can fray.

press

To set a fold or seam flat with an iron by lifting and lowering it, not sliding it.

reticule

A small drawstring handbag carried by women around 1800, when slim dresses had no room for pockets.

CORE IDEAS

For most of history, clothes had no sewn-in pockets. In the Middle Ages, men and women hung a **drawstring** purse from their belts for coins, a knife or a little sewing kit. Pickpockets were called “cutpurses,” because they slit the strings and ran off with the purse. In the 1600s to 1800s, many women wore a pair of “pockets”: flat cloth bags tied around the waist on a tape, under the skirt, reached through a slit in the side. The children’s rhyme “Lucy Locket lost her pocket” comes from those days.

Around 1800, ladies’ dresses became slim and high-waisted, and there was no room under them for tie-on pockets. So women carried a small drawstring bag on their wrist called a **reticule**. Some people joked by calling it a “ridicule.” Drawstring bags have always been

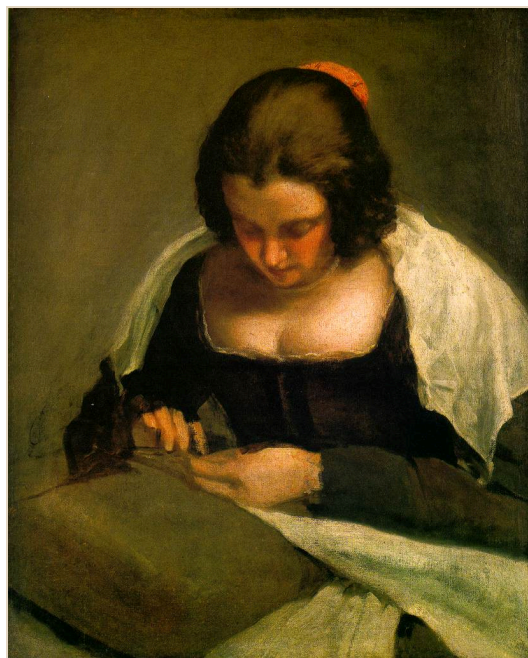
useful because they are simple: a tube of cloth, closed at the bottom, with a cord through a **casing** at the top. Pull the cord, and the opening gathers shut.

Christians have long sewn useful things for others. In the book of Acts, a disciple in Joppa named Dorcas (also called Tabitha) was “full of good works and almsdeeds.” When she died, the widows she had helped showed Peter “the coats and garments which Dorcas made.” God raised her to life through Peter, and many in Joppa believed (Acts 9:36–42). In later centuries, many churches started “Dorcas societies,” where members sewed clothing for the poor. During the First World War, American children in the Junior Red Cross sewed “comfort bags” and other useful things for soldiers and refugees.

Your bag starts with planning. Cut one rectangle 9 inches wide and 24 inches long. Fold it in half crosswise, right sides together, so it is 9 by 12, with the fold at the bottom. Sew each side with a 1/2-inch backstitched seam, starting at the bottom fold and stopping 1 1/2 inches below the top. The finished bag will be 8 inches wide. At the top, fold the **raw edge** down 1/4 inch, then 1 inch more, and **press** it. Backstitch along the lower fold to make the casing. The side opening you left lets the cord come out.

How long a cord do you need? The top of the bag goes around both front and back, so it measures $8 + 8 = 16$ inches. Add about 12 inches so the cord can hang out and be tied: about 28 inches. Pin a safety pin to one end of the cord, push it into the casing, and work it through by bunching and sliding. Knot the ends together. Now the bag can hold a sewing kit, marbles, a Bible and pencils, or a gift for someone else, as Dorcas would have done.

PICTURE STUDY



The Needlewoman, Diego Velázquez, c. 1635–1643 (also dated c. 1640–1650) · Oil on canvas · National Gallery of Art, Washington, D.C.

Wikimedia Commons · Public domain

Velázquez was the court painter to King Philip IV of Spain. This painting was never finished. The woman's face is fully painted in light and shadow, but her hands and her work are only sketched. An inventory of the painter's rooms when he died in 1660 lists "a head of a woman doing needlework," which is probably this picture.

Look closely

- Find the most finished part of the painting. Where does the light fall?
- Find the hands and the sewing. How can you tell they are not finished?
- Look at her eyes. What is she paying attention to?

Talk about it

1. What can an unfinished painting teach you about how an artist works, step by step?
2. Your bag is made in stages too. Which stage do you think matters most for a good result?

Safety first. Ironing is a parent's job or done with a parent beside you: the iron is hot, so keep fingers away from the plate, rest it on its heel, and unplug it when finished. Keep pins at right angles to the edge and pull them out as you sew.

HANDS-ON: SEW A DRAWSTRING BAG

This is the main project of the trail. Make a drawstring bag about 8 inches wide and 10 inches tall to hold your sewing kit or to give away.

You will need

- One rectangle of sturdy cotton (quilting cotton, a cut-up pillowcase or old shirt), 9 by 24 inches
- About 28 inches of cord, ribbon or a braided strip of yarn
- Needle, thread, pins, thimble, scissors, ruler and chalk
- A safety pin
- An iron and ironing board (with a parent)

Steps

1. Measure and cut the 9-by-24-inch rectangle. Fold it in half crosswise, right sides together, and pin the sides.
2. Draw a line 1/2 inch from each side. Backstitch from the bottom fold up each side, stopping 1 1/2 inches below the top. Tie off firmly.
3. Above the stitching, fold each side's seam allowance back and tack it down with a few small stitches, so the opening is neat.
4. At the top, fold the raw edge 1/4 inch to the wrong side, then fold 1 inch more. Have a parent press it. Pin.

5. Backstitch close to the lower fold all the way around, making the casing. Leave the side openings free.
6. Turn the bag right side out. Thread the cord through the casing with a safety pin, starting at one side opening and coming out the same opening. Knot the ends. Pull to close.

Check your work

- My side seams are straight and strong, with no gaps.
- The casing is wide enough for the cord to slide easily.
- The bag closes when I pull the cord, and it holds what I put in it.

FIELD NOTEBOOK

1. **Diagram: Bag layout and casing.** Draw the 9-by-24-inch rectangle to scale (1 inch on paper = 3 inches of cloth, so 3 by 8 inches). Mark the fold line, the 1/2-inch seam lines, the stop point 1 1/2 inches from the top, and the casing folds (1/4 inch and 1 inch). Beside it, draw a side view of the casing like a folded “J” with the cord inside. Label: fold, seam, casing, cord, raw edge, wrong side.
2. **Notebook entry.** Write a paragraph about who will use your bag and what it will hold. If you are giving it away, tell why you chose that person.

Did you know? Tie-on pockets could hold a surprising amount: a purse, a handkerchief, keys, a needle case, a thimble, scissors and even food. Museums such as the Victoria and Albert Museum in London keep embroidered pockets from the 1700s. The word “pocket” comes from an old word for a small bag, related to “poke,” as in “a pig in a poke.”

Goes deeper in. Arithmetic, “Measurement and Planning,” and History, “The Early Church” (Dorcas and the church at Joppa).

For families. Sources: Acts 9:36–42 (KJV); National Gallery of Art on Velázquez’s *The Needlewoman* (the museum and other sources give dates from c. 1635 to c. 1650; attribution has been discussed, but the inventory of 1660 supports Velázquez). Dorcas societies were common in English and American churches in the 1800s. The Junior Red Cross was founded in 1917; children made many items for soldiers and refugees. A bag of this size takes most children two sittings.

PRACTICE

1. **EASY** What is a casing?
2. **EASY** Who was Dorcas, and what did she make?
3. **MEDIUM** Why did women around 1800 carry reticules instead of wearing tie-on pockets?
4. **MEDIUM** A rectangle 9 inches wide is folded and sewn with 1/2-inch seams on each side. How wide is the finished bag?

5. **CHALLENGE** You want a bag 10 inches wide and 12 inches tall when finished, with 1/2-inch side seams, a fold at the bottom, and a casing that uses 1 1/4 inches at the top. What size rectangle should you cut? How long a drawstring do you need, allowing 12 extra inches?

Make it a game • What's in the Bag? A parent secretly puts one object from the house into your finished drawstring bag and pulls it shut. Feel the outside of the bag and ask up to five yes-or-no questions before guessing. Then take your turn filling the bag. (No sharp objects in the bag.)

Scripture. “Then Peter arose and went with them. When he was come, they brought him into the upper chamber: and all the widows stood by him weeping, and shewing the coats and garments which Dorcas made, while she was with them.” (Acts 9:39, KJV)

Dorcas used her needle to serve widows in need, and they remembered her by the clothes she had made. Our sewing can be a way of loving our neighbors.

Practice: answers

1. A folded and stitched tunnel of cloth that holds a drawstring or elastic.
2. A disciple in Joppa, full of good works, who made coats and garments for widows (Acts 9:36–39).
3. Their dresses were slim and high-waisted, with no room underneath for tie-on pockets.
4. 8 inches ($9 - \frac{1}{2} - \frac{1}{2}$).
5. Width: $10 + \frac{1}{2} + \frac{1}{2} = 11$ inches. Each half must be $12 + 1\frac{1}{4} = 13\frac{1}{4}$ inches tall, so the length is $26\frac{1}{2}$ inches: cut 11 by $26\frac{1}{2}$. Cord: $10 + 10 + 12 = 32$ inches.

1.7 PATTERNS AND PINNING

OBJECTIVES

- Read the symbols on a paper sewing pattern: grainline, place-on-fold, notches, cutting line and seam line.
- Find the selvage and grain of a fabric and lay out a pattern piece on it.
- Pin correctly and cut along the cutting line; tell how Ebenezer Butterick changed home sewing in 1863.

Warm-up. Take a scrap of woven cotton and pull it gently along its length, then across, then on a slant from corner to corner. Which way does it stretch most? That slanting stretch has a name, and every sewer must know about it before cutting.

Video slot. Video coming. How to read a sewing pattern for beginners: grainline, place on fold, notches; how to pin and cut a pattern. Search approved channels (a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

pattern

A paper template showing the shape of each piece to cut out of the fabric.

selvage

The tightly woven, finished edge along each long side of a piece of fabric, which does not fray.

grain

The direction of the threads in woven cloth. The lengthwise grain runs parallel to the selvage.

bias

The slanting direction across the grain, at 45 degrees, where woven cloth stretches most.

notch

A small triangle or mark on a pattern edge that shows where two pieces match when sewn.

CORE IDEAS

For centuries, clothing was cut by tailors and dressmakers who drew the shapes straight onto the cloth with chalk, or who took apart an old garment and used its pieces as a guide. Printed books of cutting diagrams for tailors appeared in Spain in the late 1500s. But most families could not buy patterns that fit. In 1863 a tailor in Sterling, Massachusetts, named Ebenezer Butterick, with his wife Ellen, began selling **graded** paper patterns: the same shirt or dress drawn in a range of sizes. They were cut from thin tissue paper and folded into

envelopes. The idea spread fast. James McCall started his pattern company in New York in 1870, and by the end of the century millions of patterns were being sold every year.

A paper pattern is full of symbols. A long straight arrow is the **grainline**. A bracket with arrows pointing to the edge means “place on fold,” so the piece is cut double. Small triangles on the edge are **notches**, which match up with notches on another piece. The thick outer line is the cutting line, and the seam line inside it is usually 5/8 inch in on most American dressmaking patterns. Each piece also carries a name or number and tells how many to cut.

Before laying out the pattern, look at the fabric. Woven cloth is made of two sets of threads: lengthwise threads that run parallel to the **selvage**, and crosswise threads that run from selvage to selvage. Lengthwise is strongest and stretches least, so most pattern pieces are placed with their grainline arrow running along it. Measure from each end of the arrow to the selvage; the two numbers must be the same, or the piece is crooked. On the **bias**, at 45 degrees, cloth stretches and drapes, which is good for a few things but bad for a bag or a shirt front.

Pins hold the paper to the fabric so nothing slips. Put the pins inside the cutting line, at right angles to the edge, every 3 to 4 inches and at each corner. When pinning two pieces of fabric together for a seam, pin across the seam line with the heads toward you, so you can pull them out easily as you sew. Cut with long, smooth strokes of your shears, keeping the lower blade on the table. Cut notches outward, as little points, rather than snipping into the seam allowance.

There is one more old rule: wash and dry cotton fabric before cutting, because cotton can shrink a little the first time it is washed. Our Lord spoke of this when He said that no one sews a piece of new, unshrunk cloth onto an old garment, or the tear becomes worse (Matthew 9:16). The best sewers plan first and cut second: measure twice, cut once.

PICTURE STUDY



Strawberry Thief (furnishing fabric), William Morris, Designed 1883 · Indigo-discharge and block-printed cotton · Victoria and Albert Museum, London (and other collections)
Wikimedia Commons · Public domain

William Morris was an English designer who loved the old ways of making things by hand. He designed this pattern after watching thrushes steal strawberries from the kitchen garden at his country house. The fabric was printed at his workshops at Merton Abbey, near London, using carved wooden blocks and indigo dye. Its design is a *repeat*: the same picture of birds and plants repeats in rows across the cloth.

Look closely

- Find the thrushes. How many can you count, and which way do they face?
- Find where the design starts to repeat. Draw a box around one full repeat with your finger.
- Find the strawberries. How do the bird and plant shapes fill the space?

Talk about it

1. If you cut a bag from this cloth, why would you have to think about which way the birds point?
2. Morris printed by hand when factories printed fast and cheap. Why do you think he chose the slower way?

Safety first. Cut with the shears flat on the table and the free hand flat on the pattern, well away from the blades. Pin with points facing away from your hand. Never cut with someone's fingers near the blades.

HANDS-ON: MAKE AND USE YOUR OWN PATTERN

Draft a paper pattern for a small flat pouch or a second drawstring bag, mark it with real pattern symbols, and pin and cut it on grain.

You will need

- Tissue paper, baking paper or old newspaper
- A ruler, pencil and paper scissors (not your fabric shears)
- Washed and pressed cotton fabric, at least 12 by 20 inches
- Pins, fabric shears and chalk
- A pattern envelope from a fabric store or library, if available, to study

Steps

1. Draw a rectangle 7 inches wide and 9 inches tall on the paper. Draw a second line 1/2 inch inside the edges: that is your seam line.
2. Mark the pattern: draw a grainline arrow up the middle, add “Cut 2,” name it “Pouch, front and back,” and draw a notch in the middle of each side.
3. Cut out the paper pattern with paper scissors.
4. Lay the fabric flat. Find the selvage. Place the pattern with its grainline arrow parallel to the selvage. Measure from both ends of the arrow to the selvage and adjust until they match.
5. Pin inside the cutting line every 3 to 4 inches and at each corner. Cut with fabric shears. Cut the notches as small outward points. Repeat for the second piece.
6. Unpin the paper and keep it in an envelope labeled with your name, the date and the seam allowance. You now own your first pattern.

Check your work

- My pattern has a grainline, notches, a name and “Cut 2.”
- My grainline measured the same distance from the selvage at both ends.
- My pins were inside the cutting line, and my pieces match.

FIELD NOTEBOOK

1. **Diagram: Pattern layout.** Draw a long rectangle for a piece of fabric. Label the two long edges “selvage” and draw a dashed line down the middle labeled “fold.” Draw two pattern pieces on it: one placed on the fold with a fold bracket, and one with a grainline arrow parallel to the selvage. Add small triangles for notches and dots for pins. Draw a slanting arrow from corner to corner and label it “bias (stretches).” Make a key for the symbols.
2. **Notebook entry.** Write a paragraph explaining why a pattern piece must follow the grain, and what could go wrong if it is cut crooked.

Did you know? The standard 5/8-inch seam allowance on American home sewing patterns leaves room to let out a seam or trim it neatly. Many quilters use 1/4 inch instead. Early Butterick patterns had no printed markings at all; sewers matched the pieces by little holes punched in the tissue.

Map or diagram. On a map of New England, find Sterling, Massachusetts, where the Buttericks began. Then find New York City, where both Butterick and McCall later had their headquarters.

Goes deeper in. Art, “Pattern and Repeat” (William Morris and the Arts and Crafts movement), and Small Business & Economics, “Mass Production and the Market.”

For families. Sources: The Butterick Publishing Company history (1863, Sterling, Massachusetts); Victoria and Albert Museum on Morris’s *Strawberry Thief* (designed 1883, printed at Merton Abbey). Juan de Alcega’s Spanish tailoring book (1580) is often named as the first printed pattern book. Ellen Butterick’s role is part of the company’s own story of how the idea began. The year McCall began is given by most sources as 1870; some say 1873, when the company was set up under his name. A note on picture use: Morris died in 1896, so his designs are in the public domain.

PRACTICE

1. **EASY** What is the selvage?
2. **EASY** What does a bracket with arrows pointing to the edge mean on a pattern?
3. **MEDIUM** How do you know a pattern piece is lying straight on the grain?
4. **MEDIUM** What did Ebenezer Butterick sell beginning in 1863, and why was it new?
5. **CHALLENGE** A pattern piece is 7 by 9 inches with a 1/2-inch seam allowance. What are the measurements inside the seam lines? If you cut 4 pieces from cloth 14 inches wide, laid two across, how long a piece of cloth do you need?

Make it a game • Symbol Snap. Make cards: on some draw pattern symbols (grainline, fold bracket, notch, cutting line, seam line, button mark); on others write their meanings. Shuffle and lay them face down. Turn over two at a time. A matching symbol and meaning is a pair to keep. The player with the most pairs wins.

Scripture. “And look that thou make them after their pattern, which was shewed thee in the mount.” (Exodus 25:40, KJV)

God gave Moses an exact pattern for the tabernacle and its furnishings, and told him to follow it with care. A good sewer follows a pattern faithfully too, and learns that careful planning comes before good making.

Practice: answers

1. The tightly woven, finished edge along each long side of the fabric that does not fray.

2. Place on fold: lay that edge on the folded edge of the fabric so the piece is cut double.
3. Measure from both ends of the grainline arrow to the selvage. The two measurements must be the same.
4. Graded paper patterns: the same design printed in a range of sizes, so ordinary families could sew clothes that fit.
5. Inside the seam lines: 6 by 8 inches. Two pieces 7 inches wide fit across 14 inches; two rows of 9 inches need 18 inches of length.

1.8 MEET THE SEWING MACHINE (WITH A PARENT)

OBJECTIVES

- Name and label the main parts of a sewing machine and tell what each does.
- Explain how a lockstitch is made with two threads, and how it differs from a hand backstitch.
- Tell the story of the sewing machine from Thimonnier (1830) and Howe (1846) to Singer (1851), and sew a first straight line with a parent.

Warm-up. Time yourself sewing backstitch for one minute on a scrap. Count your stitches. A home sewing machine can sew hundreds of stitches in a minute. Make a guess: how many times faster than you is the machine?

Video slot. Video coming. Sewing machine parts for beginners; how a lockstitch is formed (animation of needle and bobbin); history of the sewing machine, Howe and Singer. Search approved channels (Smithsonian, a 4-H or county extension channel, a sewing-school channel for children); preview first.

KEY TERMS

lockstitch

A machine stitch in which the top thread and the bobbin thread loop around each other in the middle of the cloth.

bobbin

A small spool under the needle plate that holds the lower thread.

presser foot

The small metal foot that holds the cloth flat against the feed dogs while the machine sews.

feed dogs

Little toothed bars under the presser foot that move the cloth forward one stitch at a time.

tension

How tightly the thread is held as it is fed; balanced tension makes the threads lock in the middle of the cloth.

CORE IDEAS

For thousands of years, all sewing was done by hand. In the early 1800s, inventors in several countries tried to build a machine to do it. In 1830 a French tailor, Barthélemy Thimonnier, received a patent for a machine that made a chain stitch with a hooked needle. Soon he had some 80 machines in a Paris workshop sewing army uniforms. In 1831 a mob of tailors, afraid of losing their work, broke in and destroyed the machines. Thimonnier tried again for years, but he died poor in 1857.

In America, Walter Hunt built a machine that made a **lockstitch** in the 1830s, but he never patented it. Elias Howe of Massachusetts did. On September 10, 1846, he received U.S. Patent No. 4,750 for a machine with a needle that had its eye near the point and a shuttle that carried a second thread underneath. Howe's machine worked, but few people bought it. Then in 1851 Isaac Merritt Singer, a machinist in Boston, received Patent No. 8,294 for a machine with a straight needle that moved up and down, a **presser foot** to hold the cloth, and a treadle worked by the feet. Howe sued Singer and others for using his ideas, and won. In 1856 the leading makers agreed to share their patents, and machines became cheaper and better.

Singer's company sold machines on an installment plan, so a family could pay a few dollars at a time. By 1860 it was the largest sewing machine maker in the world. Machines changed homes and towns. A mother could sew a shirt in an hour or two instead of a long day. Clothing factories grew. Many women earned money sewing at home, which fits the picture of the woman in Proverbs who "maketh fine linen, and selleth it." Electric motors came to home machines around 1900, though many farm families used treadle machines for decades longer.

How does a lockstitch work? The top thread runs from the spool through guides, the **tension** discs and the take-up lever, and down to the needle. The needle pushes a loop of top thread through the cloth. Underneath, a hook or shuttle catches the loop and passes it around the **bobbin**, which holds the lower thread. The take-up lever rises and pulls the loop tight, so the two threads lock together in the middle of the cloth. Then the **feed dogs** move the cloth forward one stitch, and it all happens again. On a balanced stitch, the top and the bottom look alike.

Learning a machine takes care. A parent should always be beside you the first times. Raise the presser foot to put the cloth in, and lower it before you sew. Keep your fingers on the cloth beside the foot, never in front of the needle. Guide the cloth; do not push or pull it, because the feed dogs do that work. Go slowly at first. Pull pins out before the needle reaches them. And when you finish, turn the hand wheel toward you to raise the needle, lift the foot, and pull the cloth out the back.

PICTURE STUDY

Sewing Machine, U.S. Patent No. 8,294 (patent drawing), Isaac Merritt Singer (inventor); drawing filed with the U.S. Patent Office, Patented August 12, 1851 · Ink drawing on paper · U.S. Patent and Trademark Office records; Singer's patent model is in the Smithsonian's National Museum of American History, Washington, D.C.

An inventor seeking a patent in the 1800s had to send careful drawings, and for many years a small working model too. Patent drawings are made to explain, not to decorate, but they have their own clean beauty. Singer's drawing shows the up-and-down needle and the presser foot that later machines still use.

Look closely

- Find the needle. Which way does it move?

- Find the part that holds the cloth down. What is it called on your machine today?
- Find letters or numbers on the drawing. Why would an inventor label every part?

Talk about it

1. Compare the drawing to a modern machine in your home or a picture of one. What has stayed the same in more than 170 years?
2. Why does a patent drawing have to be so exact?

Safety first. Use the sewing machine only with a parent beside you. Turn the power off, or unplug the machine, before threading it, changing the needle or clearing a jam. Keep fingers at least an inch from the needle, sew slowly, never sew over pins, and keep long hair tied back and loose sleeves away from the needle.

HANDS-ON: FIRST LINES ON THE MACHINE

With a parent, learn the parts, thread the machine, and sew practice lines on paper and then on cloth.

You will need

- A sewing machine and its manual (with a parent)
- Lined notebook paper or index cards, with no thread in the needle, for the first practice
- Scraps of plain cotton fabric
- Thread, a filled bobbin, pins and scissors

Steps

1. With the machine turned off, have your parent point to each part as you find it in the manual: spool pin, thread guides, tension dial, take-up lever, needle, presser foot, feed dogs, bobbin case, hand wheel, stitch-length dial, reverse lever and foot pedal.
2. Paper practice: with no thread in the needle, sew slowly along the lines of notebook paper. Then try curves and corners drawn with a pencil. Stop with the needle down, lift the foot, turn the paper and go on.
3. With the machine off, follow the manual to thread the top and put in the bobbin. Pull both threads to the back.
4. Sew a straight line on fabric, 5/8 inch from the edge, using the guide line on the needle plate. Backstitch a few stitches at the start and end with the reverse lever.
5. Change the stitch length and sew three more lines. Look at the front and back. Measure stitches per inch for each setting.
6. Last, sew two scraps together with a 5/8-inch seam and compare it with the backstitched seam you sewed by hand in Stop A3.

Check your work

- I can name and point to at least ten parts of the machine.

- I sewed a straight line with a parent beside me, keeping my fingers clear.
- My stitches look about the same on the top and bottom.

FIELD NOTEBOOK

1. **Diagram: Parts of a sewing machine.** Draw a side view of a sewing machine (use your own machine or a picture). Label at least ten parts: spool pin, thread guide, tension dial, take-up lever, needle, presser foot, feed dogs, needle plate, bobbin, hand wheel, stitch-length dial, foot pedal. Then draw a close-up box showing a lockstitch in cross-section: a line for the cloth, the top thread above and the bobbin thread below, looping together in the middle.
2. **Notebook entry.** Write a paragraph comparing hand sewing and machine sewing: speed, strength, what each is best for, and what you enjoyed most on this trail.

Did you know? Elias Howe is said to have raced his machine against five skilled hand sewers in Boston in the 1840s, and beaten them all. Many stories are told about how he got the idea for an eye near the needle's point, but they cannot be proved. After the patent cases, Howe earned money on nearly every machine sold in America and became wealthy.

Map or diagram. On a map, mark Paris (Thimonnier), Boston and Massachusetts (Howe and Singer) and New York City (where Singer's company grew). Draw an arrow showing the idea crossing the Atlantic.

Goes deeper in. History, "The Industrial Revolution" (inventions and factories), and Small Business & Economics, "Patents and Inventors."

For families. Sources: U.S. Patent No. 4,750 (Elias Howe, September 10, 1846) and No. 8,294 (Isaac M. Singer, August 12, 1851); Smithsonian National Museum of American History (Singer patent model); Science Museum Group and British Library on Thimonnier (patent 1830, workshop destroyed 1831). Walter Hunt's machine and the story that he chose not to patent it are told in many accounts with differing dates. The patent pool of 1856 is often called the "Sewing Machine Combination." Isaac Singer's private life was disorderly; the stop keeps to his work as an inventor and businessman. Please supervise every machine session, and check the machine's manual for threading.

PRACTICE

1. **EASY** What part holds the lower thread on a sewing machine?
2. **EASY** What moves the cloth forward under the needle?
3. **MEDIUM** Explain how a lockstitch is made.
4. **MEDIUM** What did Elias Howe patent in 1846, and what did Isaac Singer add in 1851?
5. **CHALLENGE** You sew 30 hand backstitches a minute. A machine sews 600 stitches a minute. How many times faster is the machine? How long would each take to sew a seam of 240 stitches?

Make it a game · Part Pointer. With the machine turned off, a parent calls out the name of a part or what it does (“holds the lower thread,” “moves the cloth”). Point to it as fast as you can. Then switch: you call and your parent points. Keep score of right answers; ten in a row wins.

Scripture. “She maketh fine linen, and selleth it; and delivereth girdles unto the merchant.” (Proverbs 31:24, KJV)

The wise woman of Proverbs 31 sewed well enough to sell her work. Machines made sewing faster, but the same virtues still matter: diligence, skill and honest work offered to others.

Practice: answers

1. The bobbin.
2. The feed dogs.
3. The needle pushes a loop of top thread through the cloth; a hook or shuttle catches it and passes it around the bobbin thread; the take-up lever pulls it tight so the two threads lock in the middle of the cloth.
4. Howe patented a lockstitch machine with an eye-pointed needle and a shuttle. Singer added a straight up-and-down needle, a presser foot and a foot treadle.
5. $600 \div 30 = 20$ times faster. By hand: $240 \div 30 = 8$ minutes. By machine: $240 \div 600 = 0.4$ minute, about 24 seconds.

TRAIL 1 BADGE QUIZ

The badge quizzes are optional and may be done orally or in writing. Answer in complete sentences. Four right out of five earns the first badge; five right out of six earns the second. Badges and the certificate are earned by doing the stops, not by scores. For questions 5 and 10, show your work.

Badge quiz 1 (Stops 1-5)

1. Name three tools in a sewing box and tell what each is for.
2. How long should a sewing thread be, and why not longer?
3. Which is stronger, the running stitch or the backstitch? Why?
4. Why does a sew-through button need a thread shank?
5. You cut two 5-inch squares for a pincushion and sew a 1/4-inch seam. What is the finished size?

Badge quiz 2 (Stops 6-8)

6. What is a casing, and what goes inside it on a drawstring bag?
7. What does Acts 9 tell us about Dorcas?
8. What do the selvage, the grainline arrow and a notch tell a sewer?
9. What did Ebenezer Butterick begin selling in 1863?
10. A machine sews 500 stitches a minute and you sew 25 by hand. How many times faster is the machine?
11. How is a lockstitch made, and who received the 1846 U.S. patent for a lockstitch machine?

TRAIL CERTIFICATE: MY SEWING PORTFOLIO AND TRAIL A CERTIFICATE

Gather your work: the labeled sewing box diagram, the knot card, the stitch sampler strip, the button card, your pincushion, your drawstring bag, your paper pattern in its envelope, and your first machine-sewn lines.

Put the eight notebook diagrams and paragraphs in order in your Field Notebook under the title "Trail A: Sewing," with your name and the dates.

Choose your best piece and write a short paragraph about how you made it and what you would improve. Show your portfolio to your family; when it is complete, a parent signs the Trail A certificate.

- **Workmanship:** Stitches are even and secure, knots are on the back, and finished items hold together in use.
- **Planning and measuring:** Cut sizes, seam allowances, cord lengths and grain are measured and figured correctly before cutting.
- **Notebook:** Each stop has a neat, labeled diagram and a clear paragraph in complete sentences, with at least one fact or date.

- **Safety and care:** Tools are used safely, pins and needles are counted back, the sewing box is kept in order, and machine work is done with a parent.

Answer key

1. Any three, such as: needle (carries thread through cloth), pins (hold cloth together before sewing), thimble (protects the finger that pushes the needle), fabric shears (cut cloth), seam ripper (takes out wrong stitches), tape measure (measures).
2. About 18 to 24 inches. A longer thread tangles, knots and wears thin.
3. The backstitch, because it leaves no gaps and each stitch loops back and overlaps on the back.
4. To raise the button above the cloth so there is room for the buttonhole cloth and the threads do not wear through.
5. 4 1/2 inches square ($5 - 1/4 - 1/4$).
6. A folded, stitched tunnel at the top of the bag; the drawstring (cord) goes through it.
7. She was a disciple in Joppa full of good works who made coats and garments for widows; God raised her to life through Peter.
8. The selvage is the finished edge of the fabric; the grainline arrow must run parallel to it; notches show where pieces match when sewn.
9. Graded paper sewing patterns, the same design in a range of sizes.
10. 20 times faster ($500 \div 25$).
11. The top thread is looped around the bobbin thread so the two lock in the middle of the cloth. Elias Howe received the patent in 1846.

CRAFTS AND MAKING ≈ TRAIL B: KNITTING AND NEEDLEWORK

The second trail of the Crafts track follows thread and yarn from the sheep to the finished piece: how wool is shorn, carded, spun and plied; finger knitting; casting on and the knit stitch; planning and knitting a first scarf; four embroidery stitches and the Bayeux Tapestry; samplers as children stitched them for centuries; charting and cross-stitching a Bible verse; and quilts, quilting bees and the story-quilts of Harriet Powers.

This is the ● **Ranger** level, for ages 10 to 13. The student reads each stop alone and works with growing independence; a parent helps with the iron, sharp tools and checking the math. Each stop has a longer story with dates and numbers, a picture study, a hands-on project, a labeled diagram and a paragraph for the **Field Notebook**, and five practice questions. Stops stand alone, but the projects build: the swatch from Stop B3 leads to the scarf in B4, and the stitches from B5 go into the sampler and verse in B6 and B7.

Five stops earn the **Needlework Ranger badge, part 1**; all eight earn part 2 and the **Trail B certificate**. The trail's finished projects are a knitted scarf and a stitched verse sampler.

BEFORE YOU BEGIN

- Read a two-page story alone and answer questions about it.
- Multiply and divide whole numbers and simple decimals, and measure in inches and fractions of an inch. Trail A (Sewing) is helpful but not required.

MASTERY CHECKLIST

- ☐ I can explain the six steps from fleece to yarn: shear, skirt, scour, card, spin and ply.
- ☐ I can cast on, knit garter stitch, keep my stitch count, bind off and weave in ends.
- ☐ I can use gauge and fabric count to turn inches into stitches and stitches into inches.
- ☐ I can work stem, chain, satin, French knot and cross-stitch neatly, and read a stitch diagram or chart.
- ☐ I can read a sampler or quilt as a primary source and tell the stories of the Bayeux Tapestry, Loara Standish and Harriet Powers.

OPTIONAL BOOKS AND RESOURCES

- **Craft Yarn Council: Learn to Knit and Standard Yarn Weights**
(<https://www.craftyarnCouncil.com>): Free step-by-step knitting instructions and the yarn weight chart used in Stops B3 and B4.
- **Smithsonian National Museum of American History: Collections Search**
(<https://americanhistory.si.edu/collections>): Search “sampler” and “quilt” for hundreds of photographed pieces, including Harriet Powers’s Bible Quilt, for Stops B6 and B8.

- **Victoria and Albert Museum: Collections and Embroidery Articles** (<https://collections.vam.ac.uk>): Jane Bostocke's 1598 sampler, opus anglicanum, Berlin woolwork and William Morris's Strawberry Thief, for Stops B5 to B7.
- **Bayeux Museum: The Bayeux Tapestry Online** (<https://www.bayeuxmuseum.com>): Zoom along the whole embroidery scene by scene for Stop B5.
- **4-H Needle Arts and Fiber projects** (<https://4-h.org>): Many state 4-H programs offer free knitting, sewing and needlework project guides and county fair classes. Ask your county extension office.

2.1 WOOL: FROM SHEEP TO YARN

OBJECTIVES

- Name the six steps that turn a fleece into yarn: shearing, skirting, scouring, carding, spinning and plying.
- Explain why wool fibers hold together when twisted (crimp and scales) and why wool stays warm when damp.
- Draw and label a flow diagram of wool's journey, and connect it to Proverbs 31:13 and 19.

Warm-up. Look at the label inside a sweater, a blanket and a pair of socks. Which ones are wool? Which are cotton or a man-made fiber like acrylic or polyester? Make a quick tally. Then pull a single strand from a piece of yarn and untwist it. What do you find inside?

Video slot. Video coming. Sheep shearing and the steps from raw fleece to spun yarn (washing, carding, spinning, plying). Search approved channels (Smithsonian, a 4-H or state extension channel, a living-history farm such as Colonial Williamsburg); preview first.

KEY TERMS

fleece

The whole coat of wool shorn from one sheep, which comes off in a single piece like a woolly rug.

lanolin

A natural grease in raw wool that keeps the sheep dry; it is washed out before spinning and is used in hand creams.

carding

Brushing clean wool between two toothed paddles (cards) so the fibers lie loose and in the same direction.

distaff

A staff that holds a bundle of prepared fiber while a spinner draws it out to twist into thread.

plying

Twisting two or more spun strands together, in the opposite direction, to make strong, balanced yarn.

CORE IDEAS

Every wool scarf begins on a sheep. Each spring a shearer clips the sheep's coat in one piece, called a **fleece**. A good shearer can shear a sheep in about two minutes without

nicking it, and the sheep, light and cool for summer, grows a whole new coat by the next year. An average American sheep gives roughly 7 to 8 pounds of raw wool a year, though a big Merino or Rambouillet can give much more.

Raw wool is not ready to use. First the fleece is laid out and **skirted**: the dirty edges, burrs and tangles are pulled away. Then it is **scoured**, washed in hot, soapy water to remove dirt and **lanolin**, the sticky grease that kept the sheep dry in the rain. A raw fleece can lose a third to half its weight in this washing. Next comes **carding**: the clean wool is brushed between two paddles covered with fine wire teeth until the fibers are fluffy and parallel. Carded wool rolled into a tube is called a *rolag*.

Why can loose fluff become strong thread? Look at a wool fiber under a microscope and you will see two things God designed into it. It has a natural wave, called *crimp*, and its surface is covered with tiny overlapping scales, like shingles on a roof. When fibers are twisted together, the crimp and scales grip one another. The same crimp traps pockets of air, which is why wool keeps you warm even when it is damp.

Spinning is adding twist. For thousands of years spinners used a *spindle*, a stick with a weight called a whorl, and a **distaff** to hold the fiber. Proverbs 31, written about three thousand years ago, describes a wise woman who “layeth her hands to the spindle, and her hands hold the distaff.” The spinning wheel reached Europe in the Middle Ages, and by the 1500s many wheels had a foot treadle that left both hands free. In colonial America, nearly every farm family spun its own yarn, and spinning bees gathered neighbors to work and talk together.

A single spun strand tends to kink and untwist. So spinners **ply** it: two or more strands are twisted together in the opposite direction, and the twists balance each other. Look closely at store yarn and you can usually count the plies. After the 1760s, inventions such as James Hargreaves’s spinning jenny and Richard Arkwright’s water frame moved spinning into mills, and one worker could tend many spindles at once.

Today most wool is spun by machines, but the steps are the same ones your great-great-grandparents knew: shear, skirt, scour, card, spin, ply. When you hold a ball of yarn, you are holding a year of a sheep’s growth and many hours of human skill.

PICTURE STUDY



The Spinners (Las Hilanderas), or The Fable of Arachne, Diego Velázquez, c. 1657 · Oil on canvas · Museo del Prado, Madrid

Wikimedia Commons · Public domain

Diego Velázquez was the court painter of King Philip IV of Spain. In this painting he shows women at work in a tapestry workshop in Madrid, probably the royal workshop of Santa Isabel. In the front, real workers spin and wind wool; in the bright room behind, finished tapestry hangs on the wall. Velázquez painted the spinning wheel turning so fast that its spokes disappear into a blur, almost two hundred years before photography.

Look closely

- Find the spinning wheel. Can you see its spokes, or only a blur? How did the painter show speed?
- Find the woman winding yarn into a ball on the right. What is she holding it from?
- Find the bundles of wool on the floor and the wall. Which steps from our story might have already happened to them?

Talk about it

1. Velázquez put the workers in the shadowy front and the fine ladies in the bright back. Why might he have arranged it that way?
2. List every tool for working wool that you can find in the painting. Which step of the journey does each one belong to?

Safety first. Wire carding brushes and pet brushes have sharp teeth; brush away from your hands. Use hot water from the tap only, not a boiling pot, when washing wool, and ask a grown-up to help.

HANDS-ON: FROM FLUFF TO YARN: A WOOL-JOURNEY CARD

You will card a little wool, spin a short strand with a simple spindle, ply it, and mount each stage on a card with a labeled diagram. If you cannot find raw wool, ask a yarn shop or a 4-H sheep family for a handful, or buy a small bag of washed wool roving at a craft store.

You will need

- A handful of washed wool or wool roving (cotton balls will work for practice, but they do not grip as well)
- Two clean pet slicker brushes or hand carders (optional)
- A pencil and an old CD or a cardboard circle about 4 inches across, with a hole in the middle, for a spindle
- A piece of cardstock, glue or tape, and colored pencils
- A magnifying glass

Steps

1. Look at a few wool fibers with the magnifying glass. Can you see the crimp (the wave)? Sketch one fiber.
2. Card a small tuft: brush it gently between two brushes, then pull it off in a fluffy pad. Roll it loosely into a rolag.
3. Make a spindle: push the pencil through the hole in the CD so it fits snugly about a third of the way from the pencil's top.
4. Tie a 12-inch piece of yarn to the pencil as a leader. Overlap the end of the leader with your wool, spin the pencil clockwise, and gently draw out the wool so the twist runs up into it. Wind each finished arm's length onto the pencil.
5. Fold your spun strand in half and let it twist back on itself. You have plied it! Notice that it no longer kinks.
6. Mount a pinch of each stage on the card in order (raw or washed wool, carded, single, plied) and label each with its step.

Check your work

- My card shows at least four stages in the right order.
- Each stage is labeled with the correct step name.
- I can explain why plying makes yarn stronger and more balanced.

FIELD NOTEBOOK

1. **Diagram: The Journey of Wool.** Draw six boxes joined by arrows across two pages: Shear → Skirt → Scour → Card → Spin → Ply. In each box draw the tool (shears, a sorting table, a washtub, a pair of cards, a spindle or wheel, two strands twisting). Under each, write one sentence about what changes. Add a magnified wool fiber in a circle at the side and label its *crimp* and *scales*.

2. **Notebook entry.** Write a paragraph: Which step in the journey would take the most time by hand, and why? Use at least two numbers or facts from the story.

Did you know? One pound of fine wool can be spun into a yarn many miles long. Wool can soak up about a third of its own weight in water and still feel dry to the touch. Sheep do not shed their wool the way dogs do, so most breeds must be sheared every year or the fleece grows too heavy and hot.

Map or diagram. On a world map, mark the great wool countries of today: Australia, China and New Zealand (the biggest producers), plus the United Kingdom and the United States. Then mark Spain, home of the Merino sheep, whose fine wool the Spanish kings once forbade anyone to take out of the country.

Goes deeper in. Gardening & Animals, “Sheep and Goats,” Life Science, “Mammals,” and History, “The Industrial Revolution” (coming soon).

For families. Sources: American Sheep Industry Association; Museo del Prado catalog; Encyclopaedia Britannica on spinning and the spinning wheel. Fleece weights vary a great deal by breed, so the stop uses a rounded average and the word “roughly.” The date the spinning wheel reached Europe is uncertain (it appears in pictures by the 1200s and 1300s); the stop says “the Middle Ages.” Proverbs 31 is traditionally connected with King Lemuel (31:1); the stop gives the age as “about three thousand years” only as a round figure. The painting’s meaning (it also tells the Greek fable of Arachne in the back room) is discussed by scholars; the stop focuses on the workshop scene.

PRACTICE

1. **EASY** Put these steps in order: spin, shear, card, ply, scour, skirt.
2. **EASY** What is lanolin, and why is it washed out?
3. **MEDIUM** Name the two features of a wool fiber that help it hold together when it is spun.
4. **MEDIUM** A raw fleece weighs 8 pounds. If washing removes 40 percent of its weight, how much clean wool is left?
5. **CHALLENGE** Why does a single spun strand kink, and how does plying fix it? Explain in two or three sentences.

Make it a game • Wool Relay. Write the six steps on six cards and lay them at one end of the room in a jumbled pile. Two teams race: one runner at a time fetches the next step in order and lays it in a line. If a runner brings the wrong card, it goes back. The first team with Shear, Skirt, Scour, Card, Spin, Ply in a correct line wins, and must name one tool for each step.

Scripture. “She seeketh wool, and flax, and worketh willingly with her hands. ... She layeth her hands to the spindle, and her hands hold the distaff.” (Proverbs 31:13, 19, KJV)

The wise woman of Proverbs 31 does not wait for wool to appear; she seeks it, and she works willingly. Spinning was slow, daily work, and Scripture honors it. Doing ordinary work gladly and well is a way of serving God and caring for others.

Practice: answers

1. Shear, skirt, scour, card, spin, ply.
2. Lanolin is the natural grease in a sheep's wool that keeps it dry. It is washed out so the wool is clean and the fibers can be carded and spun.
3. Its crimp (natural wave) and the tiny overlapping scales on its surface.
4. 40 percent of 8 is 3.2 pounds, so $8 - 3.2 = 4.8$ pounds of clean wool.
5. A single strand holds twist in one direction, so it tries to untwist and curls back on itself. Plying twists two or more strands together in the opposite direction; the opposite twists balance each other, so the yarn lies straight and is stronger.

2.2 FINGER KNITTING

OBJECTIVES

- Finger-knit a four-finger cord at least 24 inches long, using the weave-and-lift-over method.
- Explain how a knitted loop is pulled through another loop, the idea behind all knitting.
- Compare finger knitting with older cord-making tools: the lucet and the knitting spool.

Warm-up. Look around your house for cords: a shoelace, a hoodie drawstring, the cord on a window blind, a bag handle. Which ones are braided, which are twisted, and which are made of tiny loops? Make a list of three and guess how each was made.

Video slot. Video coming. Four-finger knitting for beginners: weaving the yarn and lifting loops over; finishing the cord. Search approved channels (a 4-H or state extension channel, Craft Yarn Council, a library craft channel); preview first.

KEY TERMS

loop

A ring of yarn. In knitting, every new loop is pulled through an old one, and the old loop is let go.

working yarn

The yarn that still comes from the ball, used to make new loops.

tail

The loose starting end of the yarn, left hanging so it can be woven in later.

lucet

A small two-pronged fork used in the Middle Ages and later to make square, strong cords by lifting loops over the prongs.

binding off

Finishing the knitting by passing each loop through the next so the work cannot unravel.

CORE IDEAS

All knitting rests on one simple idea: pull a new loop of yarn through an old loop, then let the old loop go. Each loop holds up the one above it, and a row of loops linked to a row of loops becomes cloth. Knitting needles are only tools for holding the loops. Your fingers can hold them too, which is why **finger knitting** is the best place to start.

In four-finger knitting, you weave the **working yarn** in and out of your four fingers to make a loop on each finger. Then you lay a second strand across the top and lift each lower loop up and over the strand and off the finger. That lift is the knit stitch in its plainest form. After a

few rows a tube of loops begins to hang down the back of your hand. Pull the **tail** gently every few rows and the tube becomes a round, springy cord.

People have made cords by lifting loops over pegs for a very long time. In the Middle Ages, and for centuries after, people used a **lucet**, a small fork of wood, bone or antler with two prongs, to make square cords. Before buttons and zippers were common, cords laced up gowns, tied sleeves to shirts and held up stockings, so every household needed miles of them. Later, children learned on a *knitting spool*, a wooden spool with four little nails on top, sometimes called a “knitting Nancy” or French knitting. Every one of these tools uses the same lift-over motion you do with your fingers.

Finger knitting teaches three habits that you will need with needles. First, *tension*: if you pull too tight the loops will not lift; too loose and the cord looks sloppy. Aim for loops that slide easily but do not fall off. Second, *counting*: knitters count rows to make pieces match. Third, *finishing*: when the cord is long enough you must **bind off** by passing the yarn through every loop, or the whole thing will unravel in seconds.

Thick, soft yarn works best, such as “chunky” or “bulky” weight. Four-finger knitting grows quickly, often about half an inch for every two rows, so a cord the length of your arm can be finished in one afternoon. Finished cords can become a bookmark, a headband, a drawstring for a bag, or several cords coiled and stitched into a small mat.

PICTURE STUDY



The Knitting Girl, William-Adolphe Bouguereau, 1869 · Oil on canvas · Joslyn Art Museum, Omaha, Nebraska
Wikimedia Commons · Public domain

William-Adolphe Bouguereau was one of the best-known French painters of the 1800s. He painted many country children with great care and smooth, lifelike skin and cloth. In this

picture a girl sits outdoors with her knitting. She looks up as if someone has just walked by, but her hands keep working.

Look closely

- Find her hands. Where is the yarn, and where is the finished knitting?
- Look at the colors around her. What is warm and what is cool?
- Is she looking at her knitting? What does that tell you about how skilled she is?

Talk about it

1. Knitters say that with practice your hands “learn” the stitch. How does this painting show that?
2. Why might a country girl of the 1800s knit while she was resting or watching animals?

HANDS-ON: A FOUR-FINGER CORD

Make a four-finger cord at least 24 inches long, and measure how fast it grows.

You will need

- Chunky or bulky yarn in a light color (dark yarn makes loops hard to see)
- Scissors
- A ruler or tape measure
- A pencil and your notebook for a tally

Steps

1. Hold your left hand up, palm toward you (or your right hand if you are left-handed). Hold the tail between your thumb and palm.
2. Weave the working yarn behind your pointer finger, in front of your middle finger, behind your ring finger and in front of your pinky. Wrap around the pinky and weave back the other way. Now every finger has a loop.
3. Lay the working yarn across the front of all four fingers, above the loops.
4. Starting with the pinky, lift the lower loop up, over the top strand, and off the back of the finger. Do this for every finger. You have finished one row. Make a tally mark.
5. Repeat steps 3 and 4. Every 10 rows, gently tug the tail and measure the cord. Write the length next to your tally.
6. To finish, cut the yarn leaving 6 inches. Thread the end through each loop from pinky to pointer, slip the loops off and pull snug. Knot it and tuck in the ends.

Check your work

- My cord is at least 24 inches long and does not unravel.
- My loops are even, not too tight and not too loose.
- I recorded rows and length at least three times.

FIELD NOTEBOOK

1. **Diagram: How a loop holds a loop.** Draw a large left hand with four fingers. Show the woven yarn in one color and the top strand in another. Draw an arrow showing a lower loop being lifted over the strand. Label: *working yarn, tail, lower loop, top strand, finished cord*. Beside it, draw a lucet (a fork with two prongs) and a knitting spool (a spool with four nails) and label each.
2. **Notebook entry.** Make a little table of your tallies (rows and inches). Then write a paragraph: About how many rows did it take to make one inch? How long would it take to make a cord long enough to go around your waist?

Did you know? Before elastic was common, stockings were held up with tied garters, and many garments were fastened with laced cords whose metal-tipped ends were called “points.” The little plastic tip on your shoelace is still called an *aglet*, an old word for such a tip.

Goes deeper in. Arithmetic, “Measuring Length” and “Rates and Ratios,” and History, “Life in the Middle Ages” (coming soon).

For families. Sources: Victoria and Albert Museum notes on knitting tools; Encyclopaedia Britannica on knitting. Lucets are well attested in Europe in later centuries; how far back they go is debated (some bone and antler finds may be lucets), so the stop says “in the Middle Ages, and for centuries after.” Growth rates in the story are typical, not exact; your child’s own tally is the real answer. Picture: Bouguereau, *The Knitting Girl* (1869), Joslyn Art Museum.

PRACTICE

1. **EASY** What is the one simple idea behind all knitting?
2. **EASY** What is the difference between the tail and the working yarn?
3. **MEDIUM** What would happen if you slid your cord off your fingers without binding off?
4. **MEDIUM** Your cord grows 3 inches every 10 rows. How many rows do you need for a 36-inch cord?
5. **CHALLENGE** A lucet, a knitting spool and finger knitting look different. What do all three have in common? Why were cords so important before zippers and elastic?

Make it a game • Cord Tug Test. Each player brings a finished cord. Lay them side by side and measure: whose is longest? Then test strength gently: hang a small cloth bag on each cord and add one spoon at a time. Count how many spoons each holds before it stretches a lot. Talk about why tighter, even loops make a stronger cord. (Do not tug hard enough to snap someone’s work.)

Scripture. “I drew them with cords of a man, with bands of love: and I was to them as they that take off the yoke on their jaws, and I laid meat unto them.” (Hosea 11:4, KJV)

God describes how He led His people Israel: not with harsh ropes but with “cords of a man, with bands of love,” the kind of gentle leading a parent gives a child. Your cord is made of many small loops, each holding the next; God’s kindness holds His people the same patient way.

Practice: answers

1. A new loop is pulled through (or lifted over) an old loop, and the old loop is let go, so each loop holds the next.
2. The tail is the loose starting end; the working yarn is the yarn still coming from the ball that makes new loops.
3. The loops would have nothing holding them, so the cord would unravel back into plain yarn.
4. $36 \div 3 = 12$ groups of 10 rows, so 120 rows.
5. All three hold loops on prongs, pegs or fingers and lift an old loop over new yarn. Cords were needed to lace and fasten clothing, tie sleeves and hold up stockings, so households used a great deal of cord.

2.3 CASTING ON AND THE KNIT STITCH

OBJECTIVES

- Cast on 15 stitches with a knitted cast-on and work several rows of knit stitch.
- Name the four motions of the knit stitch (in, around, through, off) and recognize the “V” of a finished stitch.
- Tell three facts from the history of knitting, from Egyptian socks to William Lee’s stocking frame.

Warm-up. Find something hand-knitted or machine-knitted in your house: a sweater, a sock or a knit hat. Stretch it gently sideways, then lengthwise. Which way stretches more? Look closely for rows of little “V” shapes. Each V is one stitch.

Video slot. Video coming. How to cast on (knitted or long-tail cast-on) and how to work the knit stitch, slowly, for beginners. Search approved channels (Craft Yarn Council, a 4-H or state extension channel, a library craft channel); preview first.

KEY TERMS

cast on

To make the first row of loops on a knitting needle so you have something to knit into.

slip knot

A knot with a loop that tightens when you pull the tail; it is the very first stitch.

knit stitch

The basic stitch: the right needle goes into the front of a loop, catches the yarn, pulls a new loop through, and the old loop slides off.

garter stitch

Fabric made by knitting every row; it lies flat and shows bumpy ridges on both sides.

stocking frame

A knitting machine invented by William Lee of England in 1589 that made stockings far faster than hand knitting.

CORE IDEAS

Knitting with needles is younger than spinning and weaving, but still old. The oldest true knitted pieces known are colorful cotton socks from Egypt, made roughly a thousand years ago with fine two-color patterns. By the 1200s knitting had reached Spain; silk cushions with knitted patterns were found in the royal tombs of the monastery of Las Huelgas in Burgos. Around 1400, German painters even showed Mary knitting a small garment for the child Jesus.

In England, knitting became an important trade. Woolen caps and stockings were knit by hand in towns and villages, and in 1571 Parliament passed a law that most people over six years old had to wear a woolen cap on Sundays and holy days, partly to keep the cappers in work. In 1589 a clergyman named **William Lee** of Calverton, near Nottingham, invented the **stocking frame**, a machine with rows of hooked needles. It was one of the first great textile machines, and its descendants still knit socks today.

Every piece of needle knitting begins with a **cast on**, a row of loops on the needle. There are dozens of ways to cast on. The *knitted cast-on* is easy to learn because it uses the same motion as the knit stitch itself: make a **slip knot** on the left needle, knit into it, and instead of dropping the old loop, put the new loop back onto the left needle. Repeat until you have enough stitches.

The **knit stitch** has four motions, and many teachers use a rhyme to remember them: “In through the front door, around the back, out through the window, and off jumps Jack.” *In*: the right needle goes into the front of the first loop on the left needle, from left to right. *Around*: wrap the working yarn counterclockwise around the right needle. *Through*: pull the new loop out through the old one. *Off*: slide the old loop off the left needle. Now the new stitch sits on the right needle. When all the stitches have moved across, switch the needles between your hands and begin again.

If you knit every row, you make **garter stitch**. It lies flat, does not curl, and looks the same on both sides, with ridges like ripples. Two rows make one ridge, so counting ridges is an easy way to count rows. Knitters who hold the yarn in the right hand and “throw” it around the needle knit in the *English* style; those who hold it in the left hand and “pick” it knit in the *Continental* style. Both make exactly the same stitch, so use whichever feels steady.

PICTURE STUDY



The Knitting Lesson, Jean-François Millet, 1869 · Oil on canvas · Saint Louis Art Museum, Missouri
Wikimedia Commons · Public domain

Jean-François Millet grew up on a farm in Normandy and spent his life painting French peasants at their work: sowing, gleaning, shepherding and sewing. He painted the subject of a mother teaching her daughter to knit more than once. In this version the mother does not take the needles away; she puts her hands over the child's hands so the child feels the motion.

Look closely

- Find the mother's hands and the girl's hands. Who is holding the needles?
- Find where the light comes from. What does it fall on most brightly?
- Look at the room. Is it rich or plain? What tells you?

Talk about it

1. Why is guiding someone's hands a good way to teach knitting?
2. Who taught you a skill with their hands? Describe how they did it.

Safety first. Knitting needles have points. Carry them point-down or capped, never run with them, and push them into the ball of yarn when you put your knitting away.

HANDS-ON: A PRACTICE SWATCH

Cast on 15 stitches and knit at least 10 rows of garter stitch. This swatch is your practice piece; mistakes are welcome, because they teach you to read your knitting.

You will need

- One pair of straight knitting needles, size US 8 to 10 (5 to 6 mm)
- Light-colored worsted or bulky yarn (wool or wool blend is easiest to grip)
- Scissors
- A ruler

Steps

1. Make a slip knot about 6 inches from the end and put it on the left needle. Snug it, but not tight.
2. Knitted cast-on: put the right needle into the front of the loop, wrap the yarn around, pull a new loop through, and place the new loop onto the left needle. Repeat until you have 15 stitches. Count them.
3. Knit row 1: In, around, through, off, for every stitch. Say the rhyme quietly as you go. Count: you should still have 15.
4. Switch the needles between your hands and knit row 2. After every row, count your stitches. If you have more or fewer than 15, look for a split stitch or a dropped loop and ask for help.
5. Knit to at least 10 rows (5 ridges). Measure your swatch's width and height and record them.
6. Leave the knitting on the needle; you can keep going, or start fresh for the scarf in Stop B4.

Check your work

- I cast on 15 stitches and still have 15 after every row.
- I can say and do the four motions: in, around, through, off.
- I can count ridges and know that two rows make one ridge.

FIELD NOTEBOOK

1. **Diagram: The four motions.** Draw four boxes in a row, each showing two needles and one stitch: (1) In, the right needle entering the front of the loop; (2) Around, yarn wrapped counterclockwise; (3) Through, the new loop pulled out; (4) Off, the old loop sliding off. Label the *left needle*, *right needle*, *working yarn*, *old loop* and *new loop* in the first box. Under the boxes, draw three rows of garter ridges and a close-up of one "V" stitch.
2. **Notebook entry.** Write a paragraph about your first rows. What was hardest? What mistake did you make, and how did you notice it? Include your stitch count and the size of your swatch.

Did you know? Legend says Queen Elizabeth I refused William Lee a patent, worried that his machine would put hand-knitters out of work. Lee later took his frames to France.

The story is often told and partly uncertain, but it is true that the stocking frame changed how stockings were made in England for the next two hundred years.

Map or diagram. On a map of Europe and North Africa, trace knitting's path with arrows: Egypt (early socks) → Spain (Las Huelgas, 1200s) → Germany (paintings of the "knitting Madonna," about 1400) → England (Calverton and Nottingham, the stocking frame, 1589).

Goes deeper in. History, "Tudor England" and "The Industrial Revolution," and Art, "Millet and the Painters of Country Life" (coming soon).

For families. Sources: Richard Rutt, *A History of Hand Knitting* (1987); Victoria and Albert Museum and Textile Museum notes on Egyptian knitted socks; Encyclopaedia Britannica on William Lee. Dates for the Egyptian socks range from about the 11th to the 14th century, so the stop says "roughly a thousand years ago." The 1571 Cappers Act excused nobles and certain others. The Elizabeth I patent story comes from later tradition. Millet painted this subject several times; the 1869 oil is in St. Louis. Left-handed knitters can learn the same stitch; many simply learn it as written.

PRACTICE

1. **EASY** Say the four motions of the knit stitch in order.
2. **EASY** What is garter stitch?
3. **MEDIUM** Who invented the stocking frame, and in what year?
4. **MEDIUM** Your swatch has 9 garter ridges. How many rows have you knitted?
5. **CHALLENGE** You cast on 15 stitches, but after row 4 you count 17. Give two likely causes, and explain why counting after every row is a good habit.

Make it a game · Off Jumps Jack: Speed and Count. Set a timer for two minutes. Each knitter knits as many stitches as they can, slowly enough to keep every stitch. When the timer rings, everyone counts. Score one point per stitch, but lose five points if your row count is wrong. The goal is the steadiest knitter, not the fastest.

Scripture. "And not holding the Head, from which all the body by joints and bands having nourishment ministered, and knit together, increaseth with the increase of God." (Colossians 2:19, KJV)

Paul warns against people who were not holding fast to Christ, the Head. In Christ, believers are "knit together" like stitches in one fabric, each joined to the others, and the whole body grows as God gives the growth. One loose stitch makes a hole, but stitches knit together hold.

Practice: answers

1. In, around, through, off (in through the front door, around the back, out through the window, off jumps Jack).
2. Fabric made by knitting every row; it lies flat and has ridges on both sides.
3. William Lee, a clergyman of Calverton near Nottingham, England, in 1589.
4. Two rows make one ridge, so $9 \times 2 = 18$ rows.
5. Likely causes: the yarn was wrapped over the needle at the start of a row, making an extra loop; or the needle went into a split stitch or between stitches and made a new loop. Counting after every row catches a mistake within one row, so you only have to undo a little.

2.4 A FIRST SCARF

OBJECTIVES

- Read a yarn label: fiber, weight, yardage and suggested needle size.
- Plan a garter-stitch scarf using gauge, and calculate stitches and rows from measurements.
- Begin a scarf and learn to join a new ball, bind off and weave in ends.

Warm-up. Find a ball or skein of yarn and read its paper label (the “ball band”). Write down four things it tells you. Is there a little picture of needles with a number? A square with numbers like “18 sts = 4 in”? We will learn what all of it means.

Video slot. Video coming. Knitting a beginner garter-stitch scarf: binding off, joining a new ball of yarn, weaving in ends. Search approved channels (Craft Yarn Council, a 4-H or state extension channel, a library craft channel); preview first.

KEY TERMS

yarn weight

How thick a yarn is, numbered 0 (lace) to 7 (jumbo) on the Craft Yarn Council’s chart; worsted is 4, or “medium.”

gauge

How many stitches and rows fit in a measured space, such as 18 stitches and 36 rows in 4 inches.

skein

A loosely wound bundle of yarn as it is sold; it is often wound into a ball before knitting.

bind off

To finish a piece by lifting each stitch over the next so the last row is locked and will not unravel.

weave in

To thread a yarn end with a blunt needle through the backs of several stitches so it stays hidden and secure.

CORE IDEAS

A scarf is the classic first project because it is only one long rectangle: no shaping, no seams, and it is useful when you finish. But a good knitter plans before casting on. The plan begins with the **yarn weight**. The Craft Yarn Council numbers yarn from 0 (fine lace) to 7 (jumbo). A *medium* or *worsted* yarn, number 4, knit on US size 8 needles (5 millimeters), is a sturdy and friendly choice for a first scarf.

Next comes **gauge**. Knit a small square, lay it flat, and count how many stitches fit in 4 inches. In garter stitch with worsted yarn, many knitters get about 16 to 18 stitches in 4 inches, or about 4 to 4½ stitches per inch. If you want a scarf 6 inches wide and your gauge is 4 stitches per inch, you cast on $6 \times 4 = 24$ stitches. Gauge lets you turn inches into stitches with simple multiplication. Every knitter's hands are a little different, which is why you measure your own.

How long should a scarf be? For a child, about 48 inches; for a grown-up, 60 inches or more. How much yarn will it take? A rough rule is that a 6-by-54-inch scarf in worsted garter stitch uses about 250 to 300 yards. Read the **skein** label to see how many yards each one holds, and buy all your skeins with the same *dye lot* number, because two batches of "blue" can look different side by side.

When a ball runs out, join the new one at the start of a row: drop the old yarn, leave a 6-inch tail, and begin knitting with the new yarn, also leaving a tail. Later you will **weave in** both tails. When the scarf is long enough, **bind off**: knit two stitches, lift the first over the second and off the needle, knit one more, lift again, and so on until one loop remains. Cut the yarn and pull the end through that last loop.

Scarves and caps have long been gifts of care. During the Crimean War (1853–1856), families in Britain knitted warm head coverings for soldiers in the bitter cold; the knitted face-covering hat later took its name from the Battle of Balaclava. In World War I, the American Red Cross asked Americans to knit socks, sweaters and scarves for soldiers and sailors, and schoolchildren across the country knitted squares and scarves in class. A hand-knit scarf still says the same thing it said then: someone spent hours thinking of you.

PICTURE STUDY



The Lacemaker, Johannes Vermeer, c. 1669–1670 · Oil on canvas (mounted on panel) · Musée du Louvre, Paris

Wikimedia Commons · CC BY-SA 3.0

Johannes Vermeer of Delft, in the Dutch Republic, painted only about thirty-five pictures that we know of, and this is one of the smallest: about 9½ by 8 inches, not much bigger than a sheet of notebook paper. A young woman makes bobbin lace, crossing and twisting threads wound on little bobbins around pins stuck in a pillow. Her whole attention is on her work.

Look closely

- Find her two hands. What is each one doing?
- Find the red and white threads spilling out in front. Are they sharp or soft and blurry? Why might Vermeer paint them that way?
- Find the threads she is working on. Look how thin the painter made them.

Talk about it

1. Vermeer shows the young woman's face looking down, not at us. What does this tell us about her work?
2. Lacemaking and knitting both need patience. What helps you keep your attention on slow, careful work?

Safety first. Keep knitting needles capped or pointed into the ball when you stop. Use scissors for yarn only, and a blunt tapestry needle (not a sharp sewing needle) for weaving in ends.

HANDS-ON: PLAN AND KNIT MY SCARF

Make a written plan with real numbers, then cast on and knit. A scarf takes many sittings; aim to knit a few rows every day and record your progress.

You will need

- Worsted-weight (number 4) yarn, about 250–300 yards, all from the same dye lot
- US size 8 (5 mm) straight needles, or the size on your yarn label
- A blunt tapestry needle with a large eye
- Scissors, a tape measure and your notebook

Steps

1. Read your yarn label and copy into your notebook: fiber, weight number, yards per skein, needle size and dye lot.
2. Knit a swatch of 16 stitches for about 20 rows. Lay it flat and count how many stitches fit across 2 inches. Double it to find stitches per 4 inches, then divide by 4 for stitches per inch.
3. Decide the width (5 to 7 inches) and multiply by your stitches per inch to find how many to cast on. Decide the length.
4. Cast on and knit every row. Count stitches every few rows. Measure every day and record the date and length.
5. Join new skeins at the start of a row, leaving 6-inch tails.
6. When long enough, bind off loosely. Weave each tail through about 2 inches of stitches along the edge, then trim. Add fringe if you like.

Check your work

- My plan shows my gauge, cast-on number and target length.
- My edges are fairly straight and my stitch count stays the same.
- My bind-off is loose enough that the end is as wide as the beginning.
- My ends are woven in and do not show.

FIELD NOTEBOOK

1. **Diagram: My scarf plan.** Draw a long, thin rectangle to scale (1 inch on paper = 6 inches of scarf). Label the width in inches and in stitches, the length in inches, where each new skein might begin, and the cast-on and bind-off ends. Beside it, copy the yarn label symbols (weight number, needle size, gauge square) and label what each means.
2. **Notebook entry.** Keep a progress log with dates and lengths. When you finish, write a paragraph: How long did the scarf take? Who will wear it, and what did you learn about patience?

Did you know? Knitting needles were once sized by wire gauges, where a *bigger* number meant a *thinner* needle. Today U.S. needles get bigger as the number goes up, and metric

needles are labeled by their width in millimeters. A size 8 is 5 mm in either system.

Goes deeper in. Arithmetic, “Multiplication and Division with Measurement,” Art, “Vermeer and the Dutch Masters,” and History, “The Great War” (coming soon).

For families. Sources: Craft Yarn Council, Standard Yarn Weight System; American Red Cross history pages on World War I knitting; Louvre collection notes on *The Lacemaker*. Gauge and yardage figures are typical ranges; the swatch is the real answer. The word “balaclava” for the knitted helmet is linked to the 1854 battle but seems to have come into use later in the 1800s. A first scarf may take several weeks of short sittings; that is normal.

PRACTICE

1. **EASY** What number is worsted (medium) weight yarn on the Craft Yarn Council chart?
2. **EASY** Why should all the skeins for one scarf have the same dye lot?
3. **MEDIUM** Your gauge is $4\frac{1}{2}$ stitches per inch. How many stitches do you cast on for a 6-inch-wide scarf?
4. **MEDIUM** Your scarf needs about 280 yards. Each skein has 100 yards. How many skeins should you buy?
5. **CHALLENGE** You knit 9 ridges (18 rows) for every 2 inches. How many rows will a 54-inch scarf take? If you knit 12 rows a day, about how many days will it take?

Make it a game • Guess the Gauge. A parent knits or finds three swatches of different yarns. Each player guesses how many stitches are in 4 inches of each, then everyone measures with a ruler and counts. Closest guess scores a point. Bonus point: name the yarn weight (fine, medium or bulky) just by looking.

Scripture. “And whatsoever ye do, do it heartily, as to the Lord, and not unto men;” (Colossians 3:23, KJV)

Paul wrote these words to servants in the church at Colossae, telling them their daily work could be done for Christ Himself. A scarf of hundreds of rows will test your patience. Knit each row heartily, as to the Lord, and the scarf becomes both a gift and an act of worship.

Practice: answers

1. Number 4.
2. Different dye batches of the same color can look slightly different, so the scarf would show stripes or patches.
3. $6 \times 4.5 = 27$ stitches.
4. $280 \div 100 = 2.8$, so you must buy 3 skeins (you cannot buy part of one).
5. $54 \div 2 = 27$ groups, and $27 \times 18 = 486$ rows. $486 \div 12 = 40.5$, so about 41 days.

2.5 EMBROIDERY STITCHES: STEM, CHAIN, SATIN AND FRENCH KNOT

OBJECTIVES

- Work four embroidery stitches neatly: stem, chain, satin and French knot.
- Read a stitch diagram that numbers where the needle comes up and goes down.
- Describe the Bayeux Tapestry and English “opus anglicanum” as famous examples of embroidery.

Warm-up. Look for embroidery in your home or at church: a monogram on a towel, a logo on a cap, a pattern on a pillowcase, an altar cloth or a banner. Turn it over if you can. What does the back look like compared to the front?

Video slot. Video coming. Beginner hand embroidery: stem stitch, chain stitch, satin stitch and French knot, shown close up with a hoop. Search approved channels (Royal School of Needlework, a museum textile channel such as the Victoria and Albert Museum, a 4-H channel); preview first.

KEY TERMS

embroidery

Decorating fabric with stitches of thread or yarn sewn on top of it with a needle.

floss

Embroidery thread, usually six thin cotton strands loosely twisted together that can be separated.

hoop

Two rings, one inside the other, that hold fabric tight like a drum while you stitch.

couching

Laying a thread on the surface of fabric and tacking it down with small stitches; used to fill the shapes in the Bayeux Tapestry.

opus anglicanum

Latin for “English work”: the fine gold-and-silk embroidery made in England in the Middle Ages and prized all over Europe.

CORE IDEAS

Weaving makes cloth; **embroidery** decorates cloth that is already made. With a needle and thread, an embroiderer can draw lines, fill shapes, write letters and add texture. Almost every embroidery design is built from a small set of basic stitches, and four of them will take you a long way.

Stem stitch makes a smooth, rope-like line for outlines, stems and letters. You work along the line in small, slanted, overlapping steps, each new stitch coming up halfway back along the one before. **Chain stitch** makes a line of linked loops: bring the needle up, go back down in the same hole, and come up a little farther along inside the loop of thread to catch it. **Satin stitch** fills a shape with long, smooth stitches laid side by side, like the shine of satin cloth. The **French knot** makes a little bead: wrap the thread twice around the needle, then go back down just beside where you came up, holding the wraps snug. French knots make eyes, flower centers and dots on an i.

The most famous embroidery in the world is called a tapestry, but it is not one. The **Bayeux Tapestry** is wool thread stitched onto linen. It is about 230 feet long but only about 20 inches tall, and it tells, like a long comic strip, the story of how Duke William of Normandy crossed the English Channel and won the crown of England in 1066. It was probably made in England within about twenty years of the battle, likely for William's half-brother, Bishop Odo of Bayeux. Its makers used only a few stitches: *stem stitch* and *outline stitch* for the lines and lettering, and a filling now called "Bayeux stitch," a kind of laid-and-**couched** work, for the bodies, horses and ships. It shows more than 600 people, about 200 horses, and Halley's Comet blazing in the sky.

In the 1200s and 1300s, English embroiderers became the best in Europe. Their work, called **opus anglicanum**, used silk and real gold and silver threads to stitch Bible scenes onto church robes. A list of the Pope's treasures made in 1295 named more pieces of English embroidery than of any other kind. Some of this work survives today in museums such as the Victoria and Albert Museum in London.

Good embroidery depends on three things: a **hoop** to keep the fabric tight, the right amount of **floss** (most designs use two or three of the six strands, not all six), and short lengths of thread, about as long as from your fingertips to your elbow, so it does not tangle. A neat back, with no long loose threads jumping across, is the mark of a careful embroiderer.

PICTURE STUDY

The Bayeux Tapestry: Building William's Ships, Unknown needleworkers, probably in England, 1070s · Wool embroidery on linen · Bayeux Museum, Normandy, France

Before William could cross the sea, he needed a fleet. In this part of the Bayeux Tapestry, workmen cut down trees, shape planks with axes and drill holes to build ships. Above them, a Latin inscription is stitched in letters. The needleworkers had only a few colors of wool, perhaps eight or ten, yet they showed wood grain, tools and busy men with nothing but lines and fillings.

Look closely

- Find the outlines. Are they made of single lines of stitching or wide filled areas?
- Find a ship's hull. How did the stitchers show the planks?
- Find the inscription above the scene. How are the letters made?

Talk about it

1. Why might an embroidered story be easier to carry and hang than a painted one?
2. Name two things you can learn about how people built ships nine hundred years ago from this scene.

Safety first. Embroidery needles are sharp. Keep them in a pincushion or needle book, never in your mouth or clothes, and count them at the end of each session.

HANDS-ON: A FOUR-STITCH SAMPLER STRIP

Work a practice strip with one row of each stitch, then combine them into a small flower. Keep it: you will glue a photo or the strip itself into your notebook.

You will need

- A piece of plain cotton or linen fabric about 8 by 8 inches
- A 6-inch embroidery hoop
- Embroidery floss in three colors
- An embroidery needle (size 5 to 7, sharp, with a long eye)
- A water-soluble fabric pen or a sharp pencil, and small scissors

Steps

1. Put the fabric in the hoop and tighten it until it is smooth and firm. Draw four straight 3-inch lines and, below them, a simple flower: a stem, two leaves and five small petals.
2. Cut 18 inches of floss and separate two strands. Thread the needle and knot the end.
3. Line 1, stem stitch: work small, slanted stitches along the line, each coming up halfway back along the last one.
4. Line 2, chain stitch. Line 3, satin stitch: fill a 3-inch-long, half-inch-wide band with smooth stitches side by side. Line 4, a row of French knots spaced half an inch apart.
5. Now the flower: stem stitch for the stem, satin stitch for the leaves, chain-stitch petals and a cluster of French knots in the center.
6. Finish each thread on the back by weaving it under a few stitches. Turn your work over and check the back.

Check your work

- I worked all four stitches, each in its own row.
- My stitches are about the same size and my fabric did not pucker.
- My flower uses all four stitches.
- The back of my work has no long, loose loops.

FIELD NOTEBOOK

1. **Diagram: Reading a stitch chart.** For each of the four stitches, draw a large diagram the way needlework books do: dots on a line with numbers showing where the needle comes up (odd numbers: 1, 3, 5) and goes down (even numbers: 2, 4, 6). Label each diagram with the stitch name and one use (outline, line, fill, dot).
2. **Notebook entry.** Write a paragraph comparing the front and back of your sampler strip. Which stitch was easiest, which was hardest, and why? What did the Bayeux stitchers do that you would like to try?

Did you know? The Bayeux Tapestry is made of nine linen panels sewn together so neatly that the seams are hard to find. Near the end, part of the strip is lost. In the 1800s a group of English embroiderers in Leek, Staffordshire, stitched a full-size copy, which is still on display in Reading, England.

Map or diagram. Draw the English Channel with England to the north and Normandy to the south. Mark Bayeux, the town of Pevensey where William landed, and Hastings, where the battle was fought on October 14, 1066. Draw the fleet's route across the water.

Goes deeper in. History, "The Norman Conquest" and "The Middle Ages," and Art, "Art of the Middle Ages" (coming soon).

For families. Sources: Bayeux Museum; Encyclopaedia Britannica; Victoria and Albert Museum, *Opus Anglicanum* exhibition notes (2016–2017) on the 1295 papal inventory. Measurements of the Bayeux Tapestry vary slightly (about 68–70 m long, about 50 cm high); figure counts differ by how they are counted, so the stop rounds them. Who commissioned it and exactly where it was stitched are not certain; Canterbury and Bishop Odo are the most widely held views. The French government announced a loan of the Tapestry to the British Museum during renovations of the Bayeux museum, planned for 2026–2027; check where it is on view before planning a visit. The Tapestry includes battle scenes; this stop uses a peaceful shipbuilding scene.

PRACTICE

1. **EASY** Which stitch would you use to fill a leaf shape with smooth thread?
2. **EASY** Is the Bayeux Tapestry woven or embroidered? What is it made of?
3. **MEDIUM** Why do embroiderers use a hoop?
4. **MEDIUM** The Bayeux Tapestry is about 230 feet long. A football field is 300 feet from goal line to goal line. About what fraction of the field would it cover?
5. **CHALLENGE** Floss has six strands, and a design calls for two. How many separate lengths of two strands can you get from one 18-inch piece of six-strand floss? Why do embroiderers use only part of the floss?

Make it a game • Name That Stitch. One player secretly picks a stitch and draws its diagram one step at a time on a whiteboard: first the dots, then the numbers, then the

thread path. The others try to name the stitch in as few steps as possible. Add backstitch and running stitch from Trail A to make it harder.

Scripture. “And thou shalt make an hanging for the door of the tent, of blue, and purple, and scarlet, and fine twined linen, wrought with needlework.” (Exodus 26:36, KJV)

When God gave Moses the plans for the tabernacle, He asked for needlework at its very door. Embroidery was not too small a thing for His house. God gave skill to the embroiderers of Israel (Exodus 35:35), and skilled, careful needlework can still honor Him.

Practice: answers

1. Satin stitch.
2. Embroidered: wool thread stitched onto linen.
3. It holds the fabric tight and smooth so stitches are even and the fabric does not pucker.
4. $230 \div 300$ is about 0.77, so a little more than three-quarters of the field.
5. Three ($6 \div 2 = 3$). Using fewer strands makes finer, neater stitches, and thick floss is hard to pull through fabric and can distort it.

2.6 A SAMPLER, AS CHILDREN STITCHED FOR CENTURIES

OBJECTIVES

- Explain what a sampler was for and how samplers changed from band samplers of the 1600s to schoolroom samplers of the 1700s and 1800s.
- Read a historic sampler as a primary source: who made it, when, how old they were and what they believed.
- Plan a personal sampler on graph paper with a border, an alphabet, a motif, a verse and a name and date.

Warm-up. If you had to show everything you know how to do on one small piece of cloth, what would you put on it? Make a quick list. Then ask: what would someone two hundred years from now learn about you from it?

Video slot. Video coming. Historic needlework samplers: band samplers and American schoolgirl samplers, shown by a museum curator. Search approved channels (Smithsonian, Colonial Williamsburg, Winterthur Museum, Victoria and Albert Museum); preview first.

KEY TERMS

sampler

A piece of cloth stitched with samples of stitches, letters, numbers, pictures and often a verse, to practice and record needlework skills.

band sampler

An early, long, narrow sampler with rows (bands) of patterns, used as a stitcher's pattern record and rolled up for keeping.

marking

Stitching initials and numbers onto household linen so sheets and shirts could be counted and kept track of.

motif

A small picture or design repeated or placed in a pattern, such as a tree, a house, a bird or a strawberry.

primary source

Something made by a person who lived at the time being studied, such as a letter, a diary or a sampler.

CORE IDEAS

The word **sampler** comes from the old French *essamplaire*, meaning an example or pattern. Before printed pattern books were common, a needlewoman kept her patterns by stitching a little “example” of each one onto a strip of linen. These early **band samplers** were long and

narrow, often 6 to 9 inches wide and two or three feet long, covered with rows of borders, flowers and geometric designs. They were rolled up and kept like a reference book. The earliest English sampler with a date on it was stitched by Jane Bostocke in 1598; it is now in the Victoria and Albert Museum in London.

The oldest known sampler made in America was stitched in Plymouth Colony by **Loara Standish**, daughter of Captain Myles Standish of the Mayflower, probably in the 1640s. It is kept today at Pilgrim Hall Museum. Its bands of patterns end with a prayer in thread: “Loara Standish is my name. Lord guide my heart that I may do Thy will, also fill my hands with such convenient skill as may conduce to virtue void of shame, and I will give the glory to Thy name.”

Over time samplers changed from pattern records into schoolwork. In the 1700s and 1800s, girls in Britain and America, often between about 6 and 15 years old, stitched samplers at home or at “dame schools” and academies. A typical sampler had a border, one or more alphabets, the numbers 1 to 9 or 10, a Bible verse or poem, **motifs** such as houses, trees and birds, and at the bottom the maker’s name, age and the year. The alphabets were practical: every household needed **marking**, initials and numbers stitched on sheets, towels and shirts so they could be counted on washday.

Samplers also taught more than stitching. They taught spelling, numbers, patience and Scripture. Many children stitched verses about the shortness of life and the need to remember God, such as Ecclesiastes 12:1 or lines from Isaac Watts’s hymns. Some samplers also recorded family names, birth dates, or the death of a parent or sibling, so historians use them to trace families.

That makes a sampler a **primary source**. When you study one, ask: Who made it? How old were they? Where and when did they live? What words did they choose, and what does that say about what they believed? Did they make mistakes and keep going? Large collections of samplers are kept at the Smithsonian’s National Museum of American History, Winterthur Museum in Delaware, and Colonial Williamsburg.

PICTURE STUDY

Sampler of Loara Standish, Loara Standish, Plymouth Colony, c. 1640s · Silk embroidery on linen · Pilgrim Hall Museum, Plymouth, Massachusetts

Loara Standish grew up in the young Plymouth Colony, only a generation after the Mayflower landed in 1620. Her sampler is a band sampler, long and narrow, with rows of patterns worked in colored silk. At the bottom she stitched her name and a prayer in rhyme. She did not live long; she died before her father wrote his will in 1655, so the sampler is one of the few things left that she made.

Look closely

- Count the bands of pattern. Are any repeated?
- Find the lettering. How is it different from the pattern bands?

- Look at the colors. Do you think they were this soft when new? Why might they have faded?

Talk about it

1. Read Loara's prayer again. What does she ask God for, and what does she promise?
2. What can this sampler tell us about life and faith in Plymouth Colony that a history textbook might not?

Safety first. Keep needles in a needle book or pincushion and count them when you finish. Ask a grown-up before ironing your fabric.

HANDS-ON: PLAN AND BEGIN MY SAMPLER

Design a sampler of your own on graph paper, then begin stitching the border and your alphabet in backstitch or stem stitch. You will add a cross-stitched verse in Stop B7, or finish it as its own piece.

You will need

- Graph paper and colored pencils
- Even-weave fabric (Aida cloth or linen), about 10 by 12 inches
- An embroidery hoop, floss in two to four colors, an embroidery or tapestry needle
- A water-soluble fabric pen, and small scissors

Steps

1. On graph paper, draw a rectangle for your sampler. Plan five areas: a border around the edge; an alphabet (capitals) in one or two rows; the numbers 1 to 10; a space for a short verse; and a motif such as your house, a tree or a bird. Leave a line at the bottom for your name, age and the year.
2. Pick no more than four colors and color your plan.
3. Copy the main lines lightly onto the fabric with the fabric pen.
4. Begin the border in chain stitch or stem stitch (from Stop B5).
5. Stitch the alphabet in backstitch or stem stitch, one letter at a time. Keep letters the same height.
6. Stitch your name, age and the year. Like the children of the past, you are signing a record of your work.

Check your work

- My plan has a border, alphabet, numbers, a verse space, a motif, and my name, age and year.
- I used no more than four colors.
- My letters are about the same height and evenly spaced.
- I have begun stitching and can show my progress.

FIELD NOTEBOOK

1. **Diagram: Parts of a sampler.** Draw a sampler layout in your notebook and label each part: *border, alphabet, numerals, verse, motif, maker's name, age, date*. Next to it, draw a narrow band sampler and label it *band sampler, 1600s*, and label yours *school sampler, 1700s–1800s style*.
2. **Notebook entry.** Find a historic sampler online (the Smithsonian's collection search works well). Write a paragraph reading it as a primary source: maker, age, year, place, the words she stitched and what they tell you.

Did you know? Some samplers include a mistake the stitcher left in, and some include a stitched record of how long the work took. A few boys stitched samplers too, often at schools or when learning to mark linen, but most surviving samplers were made by girls.

Map or diagram. On a map of the eastern United States, mark three sampler places: Plymouth, Massachusetts (Loara Standish, 1640s); Washington, D.C. (the Smithsonian collection); and Williamsburg, Virginia (Colonial Williamsburg's collection). Draw a line from London (Jane Bostocke, 1598) across the Atlantic to Plymouth.

Goes deeper in. History, "Plymouth Colony" and "Colonial Life," and Literature, "Isaac Watts and the Hymns of Childhood" (coming soon).

For families. Sources: Pilgrim Hall Museum; Victoria and Albert Museum (Jane Bostocke sampler, 1598); Smithsonian National Museum of American History. The Loara Standish sampler is undated; Pilgrim Hall dates it to about 1640–1650. The prayer is given here with modern spelling and punctuation. Some historic samplers include verses about death, which were common in a time of high childhood mortality; parents may wish to talk this through. Age ranges for sampler makers are typical, not fixed.

PRACTICE

1. **EASY** Where does the word "sampler" come from, and what does it mean?
2. **EASY** Who made the oldest known American sampler, and where is it kept?
3. **MEDIUM** Why did households need people who could stitch letters and numbers?
4. **MEDIUM** A sampler says "Mary Brown aged 11 years 1824." In what year was Mary probably born?
5. **CHALLENGE** Explain how a band sampler and a schoolroom sampler had different purposes.

Make it a game • Sampler Detective. A parent shows three historic samplers on a screen (the Smithsonian or Winterthur online collections). Players race to find, for each one: the maker's name, her age, the year, and one motif. One point for each correct find. Bonus point for reading a verse aloud correctly.

Scripture. "Remember now thy Creator in the days of thy youth, while the evil days come not, nor the years draw nigh, when thou shalt say, I have no pleasure in them;"

(Ecclesiastes 12:1, KJV)

The Preacher, the son of David, calls the young to remember God now, not later. Generations of children stitched this verse into their samplers so they would see it every day. Like Loara Standish, you can ask God to guide your heart and fill your hands with skill, and give Him the glory.

Practice: answers

1. From the old French *essamplaire*, meaning an example or pattern.
2. Loara Standish, daughter of Myles Standish of Plymouth Colony; it is at Pilgrim Hall Museum in Plymouth, Massachusetts.
3. To mark sheets, towels and clothing with initials and numbers so household linen could be counted and kept track of, especially on washday.
4. About 1813 ($1824 - 11 = 1813$), or 1812 if her birthday came later in the year.
5. A band sampler was a working pattern record: a needlewoman stitched examples of patterns to keep and copy later. A schoolroom sampler was a lesson and a display piece: a girl showed she could stitch letters, numbers, a verse and motifs, and signed it with her name, age and year.

2.7 CROSS-STITCH A VERSE

OBJECTIVES

- Chart a short Bible verse on graph paper, one square for each cross-stitch.
- Use fabric count to calculate how large a finished design will be.
- Work neat cross-stitches with all the top stitches slanting the same way.

Warm-up. Get a sheet of graph paper. Using only filled-in squares, make the capital letter H, then the letter O, each 5 squares tall. How many squares did each letter use? Congratulations: you have just charted your first cross-stitch letters.

Video slot. Video coming. Beginner counted cross-stitch on Aida cloth: reading a chart, starting without a knot, working rows of half-stitches and crossing back. Search approved channels (a museum textile channel such as the Victoria and Albert Museum, a 4-H channel, a library craft channel); preview first.

KEY TERMS

cross-stitch

An X-shaped stitch made of two slanted stitches crossing in the middle, worked over a square of fabric threads.

counted thread

Embroidery worked by counting the threads or holes of the fabric instead of following lines drawn on it.

Aida cloth

A cotton fabric woven in little blocks with clear holes at the corners, made for cross-stitch.

count

The number of squares (stitches) per inch of fabric; 14-count Aida has 14 squares in each inch.

chart

A grid drawing of a design in which each square stands for one stitch and each color or symbol stands for one floss color.

CORE IDEAS

Cross-stitch is one of the oldest and most widespread stitches in the world. Folk embroidery from Scandinavia to Ukraine to Palestine uses it, and it filled the alphabets on thousands of schoolroom samplers. It is a **counted-thread** stitch: instead of drawing on the fabric, you count holes. Because every X sits in one square, cross-stitch turns any design into a grid, a little like pixels on a screen, centuries before screens existed.

Modern stitchers usually use **Aida cloth**, woven in tiny blocks with a clear hole at each corner. Its **count** tells how many squares fit in an inch. On 14-count Aida, a design 70 stitches wide will be $70 \div 14 = 5$ inches wide. On 11-count, the same design will be about 6.4 inches wide, and on 18-count it shrinks to about 3.9 inches. Lower counts mean bigger squares, which are easier for beginners to see.

Every design starts as a **chart**. In the early 1800s, publishers in Berlin began printing hand-colored charts on squared paper. Stitchers all over Europe and America used them for “Berlin woolwork,” bright wool cross-stitch and tent stitch on canvas, and it became one of the most popular hobbies of the century. Charts made it possible for anyone who could count to copy a design exactly.

To make a good cross-stitch, bring the needle up at the bottom left corner of a square and down at the top right, making a half-stitch (/). Work a whole row of half-stitches, then come back the other way, crossing each one from bottom right to top left (\). The golden rule is that **all the top stitches slant the same direction**. If some lean one way and some the other, the work catches the light unevenly and looks messy, even when every X is in the right square.

Lettering a verse takes planning. Most simple cross-stitch alphabets make capital letters 5 to 7 squares tall and 3 to 5 squares wide, with one empty square between letters and three between words. So before you stitch, count: how many letters, how many spaces, how wide will the line be? If it is too wide, break the verse into two or three lines. Center each line by counting its width, subtracting it from the width of your stitching area, and splitting the leftover in half on each side.

PICTURE STUDY



Strawberry Thief, William Morris, 1883 · Indigo-discharge and block-printed cotton · Victoria and Albert Museum, London
Wikimedia Commons · Public domain

William Morris was an English designer, poet and craftsman who believed that everyday things should be both useful and beautiful. At his country home, Kelmscott Manor, thrushes kept stealing the strawberries from his kitchen garden, and Morris turned them into this famous design. It was printed at his workshops at Merton Abbey using a slow, difficult indigo-dyeing method, and it was one of the most expensive cottons he sold.

Look closely

- Find two thrushes facing each other. Is the design the same on both sides?
- Find the place where the pattern starts to repeat. How can you tell?
- Count the colors. Which color is the background?

Talk about it

1. A repeating pattern and a cross-stitch chart both depend on careful planning. What would happen if one part of the repeat were off by one square?
2. Morris turned something from his own garden into art. What from your own home or yard could become a cross-stitch motif?

Safety first. Tapestry needles for cross-stitch are blunt, but they are still needles: keep them in a needle book or pincushion and count them at the end.

HANDS-ON: CHART AND STITCH A VERSE

Choose a short verse or part of a verse (about 10 to 25 letters), chart it on graph paper, calculate its size, and stitch it. Good choices: THE LORD IS MY SHEPHERD; GOD IS LOVE; PRAY WITHOUT CEASING; or a line you love. Add the reference and a small border if you have room. This can finish the sampler you began in Stop B6.

You will need

- Graph paper, a pencil and colored pencils
- 11-count or 14-count Aida cloth, about 8 by 10 inches
- An embroidery hoop, 2 or 3 colors of floss, a size 24 or 26 tapestry needle (blunt)
- Small scissors and a ruler

Steps

1. Write your verse in capitals. Count the letters and the spaces between words.
2. Chart each letter on graph paper, 5 squares tall and 3 to 5 squares wide, with 1 empty square between letters and 3 between words. Break long verses into lines.
3. Count the width of your widest line in squares. Divide by your fabric count to find its width in inches. Make sure it fits with at least 2 inches of fabric all around.
4. Find the center of your fabric by folding it in half both ways. Count from the center to place your first letter so each line is centered.
5. Use 2 strands of floss. Start without a knot by leaving a 1-inch tail on the back and catching it under your first few stitches. Stitch each row of half-stitches, then cross back. Keep every top stitch slanting the same way.
6. Stitch the reference in a second color, and a simple border if you like. Check your chart as you go.

Check your work

- My chart shows every letter and space, and I calculated the size in inches.
- My verse is centered and spelled correctly.
- All my top stitches slant the same direction.
- The reference is stitched beneath the verse.

FIELD NOTEBOOK

1. **Diagram: How a cross-stitch is made.** Draw a large square of Aida with four holes. Number the holes 1 to 4 to show the path: 1 up (bottom left), 2 down (top right), 3 up (bottom right), 4 down (top left). Label *first half-stitch* and *top stitch*. Then glue in your verse chart, labeled with the fabric count, width and height in stitches, and width and height in inches.
2. **Notebook entry.** Write a paragraph explaining why you chose your verse and what it means. Then tell how you made it fit: what you counted, what you changed, and how you centered it.

Did you know? Cross-stitch charts work like the first digital images: a grid of squares, each filled with one color. Today some people even turn photographs into cross-stitch charts with a computer. Morris's firm, Morris & Co., also sold embroidery kits, and his daughter May Morris ran its embroidery department from 1885.

Goes deeper in. Arithmetic, "Division and Measurement" and "Ratios," and Art, "William Morris and the Arts and Crafts Movement" (coming soon).

For families. Sources: Victoria and Albert Museum (*Strawberry Thief* and Berlin woolwork); William Morris Society. The 1804 date sometimes given for the first Berlin charts is debated; the stop says "the early 1800s." Some Berlin woolwork is tent stitch rather than cross-stitch; the stop says both. Fabric sizes in the practice are rounded. If your child finds charting a whole verse too long, chart one line and stitch the reference beneath it; the math is the same.

PRACTICE

1. **EASY** What does "14-count" mean on Aida cloth?
2. **EASY** What is the golden rule for neat cross-stitch?
3. **MEDIUM** A design is 84 stitches wide. How wide will it be on 14-count Aida? On 12-count?
4. **MEDIUM** In "GOD IS LOVE" each letter is 4 squares wide, letters are 1 square apart, and words are 3 squares apart. How wide is the line in squares?
5. **CHALLENGE** Your stitching area is 60 squares wide and your line is 48 squares wide. How many empty squares go on each side to center it? On 12-count Aida, how wide is the line in inches?

Make it a game • Pixel Verse Relay. Draw a large 10-by-30 grid on poster paper. Teams take turns: a caller reads a square's address from a secret chart ("row 3, square 12") and a runner colors it in. After all the squares are filled, the hidden word or verse appears. The first team to read it aloud and give the reference wins.

Scripture. "And thou shalt write them upon the posts of thy house, and on thy gates." (Deuteronomy 6:9, KJV)

Moses told Israel to keep God's words in their hearts (6:6), to teach them to their children, and to write them where they would be seen every day. A verse stitched and hung on your wall does the same: every time you pass it, God's word is in front of you.

Practice: answers

1. There are 14 squares (stitches) in each inch of fabric.
2. All the top stitches must slant in the same direction.
3. $84 \div 14 = 6$ inches; $84 \div 12 = 7$ inches.
4. 9 letters $\times$ 4 = 36 squares. Spaces inside words: GOD has 2, IS has 1, LOVE has 3, so 6 squares. Two word gaps $\times$ 3 = 6. Total $36 + 6 + 6 = 48$ squares.

5. $60 - 48 = 12$, and $12 \div 2 = 6$ empty squares on each side. $48 \div 12 = 4$ inches.

2.8 QUILTS AND THE QUILTING BEE

OBJECTIVES

- Name the three layers of a quilt and tell the difference between piecing, appliqué and quilting.
- Calculate cutting sizes with a $\frac{1}{4}$ -inch seam allowance and plan a nine-patch block.
- Describe a quilting bee and the story-quilts of Harriet Powers.

Warm-up. Find a quilt or comforter in your home. Look at it from the side: how many layers can you feel? Look at the top: is it made of many pieces sewn together, or one piece of cloth? Can you see lines of stitching that go through all the layers?

Video slot. Video coming. How a quilt is made: piecing a nine-patch block, the three layers, hand quilting on a frame; a museum look at historic American quilts. Search approved channels (Smithsonian, International Quilt Museum, Colonial Williamsburg, a 4-H channel); preview first.

KEY TERMS

quilt

A bed covering of three layers (a top, a soft middle called batting, and a backing) held together by lines of stitching.

piecing

Sewing small pieces of fabric together edge to edge to make a larger top; also called patchwork.

appliqué

Sewing cut-out shapes of cloth on top of a background fabric (say “ap-lee-KAY”).

seam allowance

The extra fabric between the cut edge and the stitching line; quilters use $\frac{1}{4}$ inch.

quilting bee

A gathering where neighbors and friends sat around a quilt frame to stitch a quilt together, often in a single day.

CORE IDEAS

A **quilt** is a sandwich of three layers: a decorated top, a soft middle of cotton or wool *batting*, and a plain backing. The word *quilting* means the stitching that runs through all three layers and holds them together. That stitching keeps the batting from bunching up, and its lines of tiny stitches, sometimes 10 or more to the inch, can form feathers, fans, shells and diamonds.

The top can be made two main ways. In **piecing**, or patchwork, small shapes of cloth are sewn edge to edge into blocks, and the blocks are sewn together. Every piece is cut with a **seam allowance** of $\frac{1}{4}$ inch on every side, so a square that should finish 3 inches wide is cut $3\frac{1}{2}$ inches wide. In **appliqué**, shapes are cut out and stitched onto a background, like a picture made of cloth. Many patterns have old names: Nine-Patch, Log Cabin, Flying Geese, Bear's Paw, Ohio Star and Jacob's Ladder.

In early America, cloth was costly, so worn-out clothes and leftover scraps were saved and pieced into new tops. Piecing a top took weeks or months of evenings, but quilting the three layers on a big frame was too large a job for one person. So families held a **quilting bee**. Neighbors gathered around the frame, often eight or more at a time, and stitched from morning till evening while they talked. Children threaded needles and ran errands; at night there was a shared supper. In the 1840s and 1850s, women in Baltimore made famous *album quilts* in which each block was made by a different friend and often signed, as a gift for a minister, a bride or a family moving west.

One of the greatest American quilters was **Harriet Powers** (1837–1910). She was born into slavery in Georgia and after the Civil War lived with her family on a small farm near Athens. She had little or no schooling, but she knew her Bible stories well. She made story quilts in appliqué, square by square, showing Bible stories such as Adam and Eve, Noah's ark, Jonah and the whale, and the crucifixion, and also remarkable events, such as the "dark day" of May 19, 1780, and the great shower of falling stars on November 13, 1833. Two of her quilts survive: the Bible Quilt (1886) at the Smithsonian and the Pictorial Quilt (finished about 1898) at the Museum of Fine Arts, Boston.

A quilt is useful, it is beautiful, and it is a record. Quilts were given to newborns, to newlyweds and to families who had lost a home in a fire. Many are signed, dated or stitched with names, so like samplers, they are primary sources. Museums such as the International Quilt Museum in Lincoln, Nebraska, keep thousands of them.

PICTURE STUDY



Pictorial Quilt, Harriet Powers, c. 1895–1898 · Cotton, pieced and appliquéd, hand and machine stitched ·
Museum of Fine Arts, Boston
Wikimedia Commons · Public domain

Harriet Powers made this quilt in Georgia near the end of the 1800s. It has fifteen panels arranged in rows. Some show Bible stories and some show events people in the South still talked about, like a day when the sky went dark at noon and a night when stars seemed to fall like rain. Powers cut every figure from cloth and stitched it down by hand.

Look closely

- Count the panels. How are they arranged?
- Find stars or suns. How many points do they have? How were they made from cloth?
- Find a panel with animals. Which animals can you name?

Talk about it

1. Powers told her stories in cloth instead of in writing. What are the advantages of telling a story with pictures?
2. If you made a story quilt of your family's history and faith, what four panels would you include?

Safety first. Rotary cutters used by quilters are extremely sharp; use scissors unless a grown-up is right beside you and the blade is closed whenever you set it down. Keep pins in a pincushion, and ask before using an iron.

HANDS-ON: A NINE-PATCH BLOCK

Cut and hand-sew a nine-patch block with running stitch (from Trail A). If you have friends or siblings, hold a small quilting bee: each person makes one block, and together you plan a quilt or a pillow.

You will need

- Two cotton fabrics that look good together, one light and one dark (old shirts work well)
- A ruler, a pencil or fabric marker, and fabric scissors
- A cardboard template $3\frac{1}{2}$ inches square
- A sewing needle, thread, pins, and an iron (with a grown-up)

Steps

1. Trace the $3\frac{1}{2}$ -inch template and cut 5 dark squares and 4 light squares. Each will finish at 3 inches.
2. Lay them out in three rows like a checkerboard: dark-light-dark, light-dark-light, dark-light-dark.
3. Draw a line $\frac{1}{4}$ inch from the edge on the back of each square. Pin two squares face to face and sew along the line with small running stitches. Sew each row of three.
4. Press the seams toward the dark squares with a grown-up's help.
5. Pin the rows together, matching the corners, and sew them. Your block should measure $9\frac{1}{2}$ inches, and will finish at 9 inches when sewn into a quilt.
6. Lay out everyone's blocks together and plan how many you would need for a pillow or a bed quilt.

Check your work

- I cut 9 squares at $3\frac{1}{2}$ inches and sewed with a $\frac{1}{4}$ -inch seam.
- My corners line up fairly well where four squares meet.
- My block measures about $9\frac{1}{2}$ inches square.
- I can explain why I cut $3\frac{1}{2}$ inches for a 3-inch finished square.

FIELD NOTEBOOK

1. **Diagram: Inside a quilt.** Draw a cross-section of a quilt like a sandwich and label the *top*, *batting*, *backing* and the *quilting stitches* going through all three. Next to it, draw your nine-patch block on graph paper (1 square = 1 inch), shade the dark squares, and label the *cut size* ($3\frac{1}{2}$ in), *finished size* (3 in), *seam allowance* ($\frac{1}{4}$ in) and the *block size* (9 in finished).
2. **Notebook entry.** Write a paragraph about a quilting bee from the point of view of a child in the 1800s: who came, what you did, and how long it took. Use at least three facts from the story.

Did you know? Harriet Powers showed her Bible Quilt at a cotton fair in Athens, Georgia, in 1886. A local art teacher, Jennie Smith, asked to buy it; a few years later, when times were hard, Powers sold it to her for five dollars. Smith wrote down Powers's own explanations of each panel, which is how we know what she meant by them.

Map or diagram. On a U.S. map, mark Athens, Georgia (Harriet Powers); Baltimore, Maryland (album quilts); Washington, D.C. (the Smithsonian's Bible Quilt); Boston (the Pictorial Quilt); and Lincoln, Nebraska (the International Quilt Museum).

Goes deeper in. History, "Pioneer and Frontier Life" and "The Civil War and Reconstruction," Arithmetic, "Fractions and Measurement," and Small Business & Economics, "Thrift and Using What You Have" (coming soon).

For families. Sources: Museum of Fine Arts, Boston; Smithsonian National Museum of American History; International Quilt Museum. The Pictorial Quilt's exact dates and the details of how it was commissioned are uncertain; the museum dates it about 1895-1898. Panel subjects are given from the museum's description and the notes recorded by Jennie Smith and others. You may meet the claim that quilts were used as secret codes on the Underground Railroad; historians have found no evidence from the period for it, so this stop leaves it out. Harriet Powers's life in slavery is stated plainly; older students can read more in the History course.

PRACTICE

1. **EASY** Name the three layers of a quilt.
2. **EASY** What is the difference between piecing and appliqué?
3. **MEDIUM** You want a square that finishes 4 inches. With a $\frac{1}{4}$ -inch seam allowance, what size do you cut it?
4. **MEDIUM** A quilt has 6 rows of 8 nine-patch blocks. How many blocks is that, and how many small squares?
5. **CHALLENGE** Each block finishes at 9 inches. How big is the 6-by-8-block quilt in inches? If 6 people at a quilting bee each quilt one block an hour, about how long will the quilting take?

Make it a game • Quilt Block Puzzle. Cut 9 squares of light paper and 9 of dark, about 3 inches each. A caller names a pattern (Nine-Patch, Checkerboard, Diagonal Stripe, Plus Sign) and players race to lay a 3-by-3 block that matches. Then each player invents a block and gives it a name, the way quilters did for hundreds of years.

Scripture. "Now there was at Joppa a certain disciple named Tabitha, which by interpretation is called Dorcas: this woman was full of good works and almsdeeds which she did." (Acts 9:36, KJV)

Dorcas used her needle to make coats and garments for the widows of Joppa (Acts 9:39). When she died, they showed Peter the clothes she had made, and God raised her to life through Peter. A quilt made for someone in need, or stitched together at a bee, can be a work of love like hers.

Practice: answers

1. The top, the batting (middle) and the backing.
2. Piecing sews pieces edge to edge to make a top; appliqué sews cut-out shapes on top of a background fabric.
3. $4\frac{1}{2}$ inches ($\frac{1}{4}$ inch added on each of two sides, so $\frac{1}{2}$ inch in all).
4. $6 \times 8 = 48$ blocks; $48 \times 9 = 432$ small squares.
5. $6 \times 9 = 54$ inches by $8 \times 9 = 72$ inches, so 54 by 72 inches. $48 \text{ blocks} \div 6 \text{ people} = 8 \text{ hours}$, about one long day.

TRAIL 2 BADGE QUIZ

The badge quizzes are optional and may be done open-notebook. The student writes answers in full sentences; a parent checks them with the answer key. Four right out of five earns the first badge; five right out of six earns the second. Badges and the certificate are earned by doing the stops and projects, not by scores.

Badge quiz 1 (Stops 1-5)

1. Put the steps from sheep to yarn in order, and tell what carding does.
2. What is the one idea behind all knitting, and why must you bind off?
3. Name the four motions of the knit stitch. Who invented the stocking frame, and when?
4. Your gauge is 4 stitches per inch. How many stitches do you cast on for a 7-inch-wide scarf?
5. Is the Bayeux Tapestry woven or embroidered? What event does it show, and which stitch is used for its outlines?

Badge quiz 2 (Stops 6-8)

6. What was a band sampler for, and how was a schoolroom sampler different?
7. Who was Loara Standish, and why is her sampler important?
8. A cross-stitch design is 98 stitches wide. How wide will it be on 14-count Aida?
9. What is the golden rule for neat cross-stitch?
10. Name the three layers of a quilt. What size do you cut a square that will finish at 2 inches?
11. Who was Harriet Powers, and what did her quilts show?

TRAIL CERTIFICATE: MY NEEDLEWORK PORTFOLIO AND TRAIL B CERTIFICATE

Gather your work: the wool-journey card (B1), a finger-knit cord (B2), your swatch (B3), your finished scarf with its written plan (B4), your four-stitch strip (B5), your sampler or verse cross-stitch with its chart (B6 and B7), and your nine-patch block (B8). Photograph pieces that are too big for the notebook.

Include your eight Field Notebook diagrams and paragraphs, labeled with stop numbers and dates.

Choose your best piece and write a half-page reflection: how you planned it, what went wrong and how you fixed it, and who it is for. When the portfolio is complete, a parent signs the Trail B certificate.

- **Craftsmanship:** Stitches are even; knitting keeps its stitch count; ends are woven in; the backs of embroidered pieces are tidy.
- **Planning and math:** Plans for the scarf, verse chart and quilt block show correct gauge, count and seam-allowance calculations.
- **History and sources:** The student can explain the wool journey and read a sampler or quilt as a primary source, using names and dates correctly.

- **Notebook and diligence:** Diagrams are labeled and neat, paragraphs are complete, and long projects were carried through to the end “heartily, as to the Lord.”

Answer key

1. Shear, skirt, scour, card, spin, ply. Carding brushes clean wool between toothed paddles so the fibers are loose and lie in the same direction for spinning.
2. A new loop is pulled through or lifted over an old loop, so each loop holds the next. You bind off to lock the last loops; otherwise the work unravels.
3. In, around, through, off. William Lee of Calverton, near Nottingham, England, in 1589.
4. $7 \times 4 = 28$ stitches.
5. Embroidered (wool on linen). It shows William of Normandy’s conquest of England in 1066. Its outlines and letters are in stem (and outline) stitch.
6. A band sampler was a long, narrow pattern record kept for reference. A schoolroom sampler was a lesson and display piece with alphabets, numbers, a verse, motifs and the maker’s name, age and year.
7. The daughter of Myles Standish of Plymouth Colony. Her sampler, from about the 1640s, is the oldest known American sampler and records her prayer for God’s guidance and skill.
8. $98 \div 14 = 7$ inches.
9. All the top stitches slant the same direction.
10. Top, batting and backing. Cut it $2\frac{1}{2}$ inches (a $\frac{1}{4}$ -inch seam allowance on each side).
11. A Georgia quilter (1837–1910), born into slavery, who made appliqué story quilts showing Bible stories and remarkable events such as the dark day of 1780 and the falling stars of 1833. Her quilts are at the Smithsonian and the Museum of Fine Arts, Boston.

CRAFTS AND MAKING ≈ TRAIL C: PAPER AND HAND CRAFTS

The third trail of the Crafts and Making track is about paper and the small hand crafts made from it. It follows paper from Egyptian papyrus and Cai Lun's China to the Rittenhouse mill of 1690; folds a crane from the 1797 *Secret of Folding a Thousand Cranes*; traces our letters from Trajan's Column to the copybooks of the writing masters; tells how the Penny Post of 1840 gave us the greeting card; rolls quillwork like the schoolgirls of colonial Boston; presses flowers as botanists and young Emily Dickinson did; sews a book the way binders have since the codex replaced the scroll; and strings beads with a glance at Venetian glass, wampum and pearls.

This is the  **Ranger** level, for ages 10 to 13. The student reads each stop alone, in about 25 to 35 minutes, then makes the project with a labelled map or diagram, writes a short notebook entry, and answers five practice questions with answers to check. Every stop stands by itself, and each one adds a finished sample to a **Paper and Hand Crafts portfolio**, ending in a hand-sewn notebook and a beaded piece.

Five stops earn the **Paper Crafts Ranger badge, part 1**; all eight earn part 2 and the **Trail C certificate**. A student who did the  Scout stops will find new history, measuring and planning here; a student starting fresh needs nothing but this trail.

BEFORE YOU BEGIN

- Read a page of history alone and write a paragraph about it.
- Measure to the nearest $\frac{1}{8}$ inch with a ruler and use scissors and a craft needle safely.

MASTERY CHECKLIST

- ☐ I can tell the story of paper from papyrus to the paper mill, with dates and places.
- ☐ I can read and draw origami diagram signs and fold a crane.
- ☐ I can rule guidelines and letter a verse in italic with a steady pen angle.
- ☐ I can score, fold, quill, press and seal paper and flowers neatly, and label my work.
- ☐ I can sew a pamphlet-stitch notebook and string a planned bead pattern with a clasp.

OPTIONAL BOOKS AND RESOURCES

- **Robert C. Williams Museum of Papermaking (Georgia Tech)**
(<https://paper.gatech.edu>): History of papermaking, with pictures of moulds, vats and watermarks, for Stop C1.
- **Origami USA** (<https://origamiusa.org>): Free diagrams, including the traditional crane, and a guide to diagram symbols, for Stop C2.
- **Emily Dickinson Herbarium (Harvard, Houghton Library)**
(<https://library.harvard.edu>): Search "Emily Dickinson herbarium" to page through all 66 leaves online, for Stop C6.

- **British Library: Discovering Sacred Texts and Medieval Manuscripts**
(<https://www.bl.uk>): Images of Codex Sinaiticus, the St Cuthbert Gospel and many scripts, for Stops C3 and C7.
- **The Metropolitan Museum of Art Collection**
(<https://www.metmuseum.org/art/collection>): Search “quillwork sconce,” “Jost Amman” and “beads” for objects from Stops C5, C7 and C8.

3.1 PAPER: FROM PAPYRUS TO THE PAPER MILL

OBJECTIVES

- Tell apart papyrus, parchment and true paper, and say what each was made from.
- Trace the journey of papermaking from China to the Middle East, Europe and colonial America, with key dates.
- Name the tools and steps of a hand paper mill: vat, mould, deckle, couching, pressing and drying.

Warm-up. Tear a sheet of copy paper and a paper towel, and look closely at the torn edges with a magnifying glass if you have one. What do you see sticking out? Those tiny hairs are fibers. Every sheet of paper is a mat of fibers that were once loose in water.

Video slot. Video coming. How paper was made by hand in a historic paper mill: vat, mould and deckle, couching and pressing; how papyrus was made in ancient Egypt. Search approved channels (Smithsonian, Colonial Williamsburg, the Robert C. Williams Museum of Papermaking, a historic paper mill or museum channel); preview first.

KEY TERMS

papyrus

A writing material made in ancient Egypt by laying thin strips of the papyrus reed crosswise in two layers and pressing them together. It is not true paper, because the fibers are never broken apart and re-formed.

parchment

A writing material made from animal skin (calf, sheep or goat) that has been scraped, stretched and dried. Fine calfskin parchment is called vellum.

pulp

Plant fibers beaten apart and floating in water. True paper is made by lifting a thin layer of pulp out of the water on a screen.

mould and deckle

The papermaker's two-part tool: the mould is a wooden frame with a fine wire screen; the deckle is a loose frame that sits on top and sets the edge and size of the sheet.

watermark

A design that shows when a sheet is held up to the light, made by a wire picture sewn onto the mould. The paper is slightly thinner where the wire was.

CORE IDEAS

Long before paper, people wrote on clay, stone, wax and wood. In Egypt, scribes used **papyrus**, made from a tall reed that grew along the Nile. The stalk was cut into thin strips, one layer was laid side by side, a second layer was laid across it, and the two were pressed

and dried. Sheets were pasted end to end into scrolls, some more than 100 feet long. Farther north, where papyrus would not grow, people used **parchment**, scraped animal skin. It was strong and could be folded, but a single large book might need the skins of more than a hundred animals.

True paper was first made in China. Chinese records say that in AD 105 a court official named **Cai Lun** presented a new method to the emperor: bark, hemp, old rags and fishing nets were soaked and beaten into **pulp**, lifted out on a screen, and dried in thin sheets. Archaeologists have found rougher paper that is even older, so Cai Lun probably improved the craft rather than inventing it. Either way, the secret is the same today: break fibers apart in water, then let them knit back together as a flat mat.

For centuries the method stayed in Asia. By the 700s paper was being made in Samarkand in Central Asia, and by about 795 there was a paper mill in Baghdad. Muslim lands filled with books and libraries. Papermaking reached Spain by the 1100s, and Italy by the 1200s, where the town of **Fabriano** made fine paper, sized with animal gelatin, and began to use the **watermark** around 1280. Germany had its first mill at Nuremberg in 1390. When Johannes Gutenberg began printing in the 1450s, cheap paper was ready for him.

In a European hand mill, linen rags were rotted, then pounded by water-powered hammers into pulp. The **vatman** dipped the **mould and deckle** into the warm vat, lifted it level, and gave it a shake to lock the fibers together. The **coucher** (say “KOO-sheer”) turned the wet sheet out onto a woolen felt. A stack of 144 sheets and felts, called a **post**, was squeezed in a great screw press, and the sheets were hung over ropes to dry. A good team could make thousands of sheets a day. Paper was counted in quires (24 or 25 sheets) and reams (480, later 500).

The first paper mill in the American colonies was built in 1690 by **William Rittenhouse**, a German-born papermaker and Mennonite minister, on a creek near Germantown, Pennsylvania. For more than a century Americans still made paper from rags, and newspapers begged readers to save them. Then, in the 1800s, two inventions changed everything: the **Fourdrinier machine**, patented in England in the early 1800s, which made paper in one endless roll, and methods for making pulp from wood. Paper became so cheap that we now use it once and throw it away, though people once saved every scrap.

PICTURE STUDY

Papermaking, from The Exploitation of the Works of Nature (Tiangong Kaiwu), Song Yingxing (author), with woodblock illustrations by unknown Chinese artists, 1637 · Woodblock-printed book illustration · Copies in many libraries, including the Library of Congress and the National Library of China

Song Yingxing (c. 1587–1666) was a Chinese scholar who wrote down how ordinary things were made: rice, salt, iron, cloth and paper. His book, printed in 1637 during the Ming dynasty, shows papermakers turning bamboo into pulp, lifting sheets out of a vat on a fine screen, pressing them, and drying them on a heated wall. The steps are much like those in a European mill, though the two crafts grew up thousands of miles apart.

Look closely

- Find the vat and the screen. How is the worker holding it?
- Find the stack of wet sheets or the press. What is squeezing the water out?
- Find the drying wall or fire. Why would heat help?

Talk about it

1. Compare this picture with the steps of a European hand mill in the story. Which steps are the same?
2. Why do you think Song Yingxing wanted to record how common things were made?

Safety first. Ask a grown-up to run the blender for the pulp, and never put your hand in it. Wipe up drips at once so no one slips.

HANDS-ON: MAKE A SHEET OF PAPER AND DIAGRAM THE MILL

Recycle scrap paper into a new handmade sheet, the same way the vatman did, and draw a labelled diagram of the steps.

You will need

- Scrap paper (newsprint, printer paper or egg cartons), torn into postage-stamp pieces
- A blender (with a grown-up) and warm water
- A wide plastic tub for a vat
- A mould: a picture frame or embroidery hoop with window screen stretched across it; an empty frame of the same size makes a deckle
- Old towels or felt, a sponge and a heavy book

Steps

1. Soak the torn paper in warm water for an hour or overnight.
2. With a grown-up, blend a handful of soaked paper with about 3 cups of water until it looks like thin oatmeal. Pour it into the tub and add more water.
3. Stir the vat. Hold the deckle on top of the mould, dip them in at the far side, scoop toward you, and lift them out level. Give a gentle shake side to side and front to back.
4. Lift off the deckle. "Couch" the sheet: flip the mould face down onto a towel, press hard with a sponge to soak up water, and peel the mould away.
5. Cover with another towel, press under a heavy book for ten minutes, then let the sheet dry flat for a day.
6. Draw the diagram: five boxes in a row joined by arrows, labelled *1 Beat the pulp, 2 Dip and lift (vat, mould, deckle), 3 Couch onto felt, 4 Press, 5 Dry*. Under each box draw a small picture of the tool used.

Check your work

- I made at least one sheet that holds together when dry.

- My diagram shows five steps in order, with tools labelled.
- I can explain why papyrus is not true paper.

FIELD NOTEBOOK

1. **Notebook entry: The journey of paper.** Write a paragraph tracing paper from China to your own home. Use at least four places and three dates from the story.
2. Draw a simple map: mark China, Samarkand, Baghdad, Spain, Italy (Fabriano), Germany (Nuremberg) and Pennsylvania. Join them with an arrow in order and write a date beside each.
3. Glue a small corner of your handmade paper into the notebook.

Did you know? The word *paper* comes from *papyrus*, and the word *Bible* comes from *byblos*, the Greek word for papyrus (named after a Phoenician port that traded it). The American Declaration of Independence and the Constitution were written on parchment, not paper.

Map or diagram. On your map, the path of paper bends west across Asia, then along the Mediterranean, then north through Europe and across the Atlantic. It took more than 1,500 years to travel from China to Pennsylvania.

Goes deeper in. History, “The Middle Ages” and “The Printing Press,” and Geography, “Asia” (coming soon).

For families. Sources: Britannica, “Paper”; Robert C. Williams Museum of Papermaking; Historic RittenhouseTown. The AD 105 date for Cai Lun comes from the Chinese *Book of the Later Han*; older paper fragments have been found, so the stop says he “probably improved” the craft. The story that papermaking reached Samarkand through Chinese prisoners taken at the Battle of Talas (751) is often told but uncertain, so it is left out. Dates for the first Baghdad mill and the first watermarks vary by a few years in different sources.

PRACTICE

1. **EASY** What were papyrus and parchment each made from?
2. **EASY** In what country was true paper first made, and who is traditionally named as its inventor?
3. **MEDIUM** Why is papyrus not counted as true paper?
4. **MEDIUM** Put these in order: Rittenhouse mill, Cai Lun, Fabriano watermarks, Baghdad mill.
5. **CHALLENGE** A mill team made 2,500 sheets a day. A ream was 480 sheets. How many full reams did they make in a day, and how many sheets were left over?

Make it a game • Vatman, Coucher, Layman. Three players stand in a row. The vatman “dips” a sheet (a paper plate) from a bucket and passes it on; the coucher lays it

on a towel pile; the layman lifts it off and hangs it on a string with a clothespin. Time how many sheets your mill can make in two minutes without dropping one. Then switch jobs and try to beat the record.

Scripture. “The cloke that I left at Troas with Carpus, when thou comest, bring with thee, and the books, but especially the parchments.” (2 Timothy 4:13, KJV)

Near the end of his life, the apostle Paul asked Timothy to bring his books and parchments. God chose to give His Word in writing, and His people have always treasured the materials that carry it.

Practice: answers

1. Papyrus was made from strips of the papyrus reed pressed in two crossing layers; parchment was made from scraped and stretched animal skin.
2. China; the court official Cai Lun, in AD 105.
3. Because its fibers are never beaten apart into pulp and re-formed; the reed strips are only laid crosswise and pressed together.
4. Cai Lun (105), Baghdad mill (about 795), Fabriano watermarks (about 1280), Rittenhouse mill (1690).
5. $2,500 \div 480 = 5$ full reams (2,400 sheets), with 100 sheets left over.

3.2 ORIGAMI: FOLDING PAPER PRECISELY

OBJECTIVES

- Read origami diagram symbols for valley folds, mountain folds and turning the model over.
- Fold a traditional crane from a square, step by step, with sharp, accurate creases.
- Explain how folding paper connects to geometry and to counting by doubling.

Warm-up. Take a rectangle of copy paper and make it into a perfect square without a ruler. (Hint: fold one short edge down to meet a long edge, crease, and cut off the extra strip.) How do you know your square is really square?

Video slot. Video coming. How to fold a traditional origami crane step by step; how to read origami diagrams (valley fold, mountain fold). Search approved channels (Origami USA, the Smithsonian, a children’s museum or library channel); preview first.

KEY TERMS

origami

The Japanese art of folding paper into shapes, usually from one square sheet without cutting or glue (from *ori*, “fold,” and *kami*, “paper”).

valley fold

A fold that brings the paper toward you, so the crease sinks like a valley. Shown in diagrams by a dashed line.

mountain fold

A fold that pushes the paper away from you, so the crease rises like a ridge. Shown in diagrams by a dash-and-dot line.

base

A standard shape folded first and used to start many models, such as the square base or the bird base.

crease pattern

The lines left on a sheet when a model is unfolded. It is like a map of every fold.

CORE IDEAS

Wherever there was paper, people folded it. In China and Japan, paper was folded for ceremonies long before it was folded for fun. In Japan, gifts were wrapped with folded paper decorations, and Shinto shrines used folded paper streamers. By the Edo period (1603–1868), when paper had become cheaper, folding birds, boats and boxes had become a pastime. In 1797 a book printed in Kyoto, *Hiden Senbazuru Orikata* (“The Secret of Folding a Thousand Cranes”), showed 49 ways to fold cranes joined at the wing tips from a single cut sheet. It is the oldest known book of recreational folding.

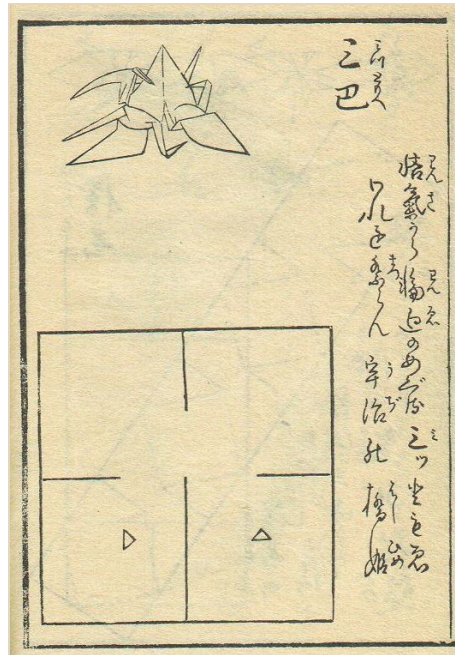
Europe had its own folding traditions: napkins folded into fancy shapes for banquets, and the “pajarita,” a little paper bird of Spain. In the 1830s and 1840s the German teacher **Friedrich Froebel**, who began the first kindergarten, used paper folding to teach small children about shapes, halves and angles. When Japan opened to the West in the 1850s and 1860s, Japanese and European folding met.

The modern art owes most to **Akira Yoshizawa** (1911–2005), who created thousands of new models and a simple set of drawing signs to show how to fold them. With a few Western folders who wrote about his work, this became the standard system every origami book uses today. A dashed line means a **valley fold**, a dash-and-dot line means a **mountain fold**, a looping arrow means “turn the model over,” and an arrow with a hollow head means “fold and unfold.” Because of these signs, a child in Ohio can fold a model invented in Tokyo without a word of Japanese.

Many models begin with the same few **bases**. The crane starts with a square base, which becomes a **bird base** through two “petal folds.” Unfold a finished crane and you will see its **crease pattern**: a web of lines that are all halves, quarters and diagonals of the square. Folders have discovered real mathematics this way. Every fold line is a straight line, the angles around any point add up to 360°, and engineers have borrowed folding patterns to pack solar panels and airbags into small spaces.

Folding is also a lesson in doubling. Fold a sheet in half once and it is 2 layers thick; twice, 4; three times, 8. Each fold doubles the layers, so 7 folds make 128 layers, and it becomes almost impossible to fold again. People long said no one could fold paper in half more than 7 or 8 times. In January 2002 a California high school student, **Britney Gallivan**, worked out the math and folded a single long strip of thin paper in half 12 times, making 4,096 layers. Precise folding rewards patience: one crooked crease early on throws every later fold off.

PICTURE STUDY



*Pages from Hiden Senbazuru Oriката (The Secret of Folding a Thousand Cranes), Akisato Ritō (writer), with folds devised by the priest Rokoan, 1797 · Woodblock-printed book · Copies in Japanese libraries and in collections such as the Library of Congress
Wikimedia Commons · Public domain*

The folds in this book are credited to Rokoan, a Buddhist priest of Kuwana, and the text to Akisato Ritō, a Kyoto writer of popular illustrated guides. Each page shows a square sheet with small cuts that leave the cranes joined, then the finished group. Some sets have two cranes, some ten, some nearly a hundred tiny birds.

Look closely

- Find the cut lines on the square. Where do the cranes stay joined?
- Find the smallest crane on the page. How large would its square have been?
- Look at the shapes of the wings. Are all the cranes folded the same way?

Talk about it

1. This book allows cuts, but most modern origami does not. Which do you think is harder, and why?
2. Why would a set of joined cranes require more care than a single crane?

HANDS-ON: FOLD A CRANE AND MAP ITS CREASES

Fold a traditional crane from a diagram, then fold a second one, unfold it, and turn its creases into a labelled diagram.

You will need

- Several squares of origami paper or thin copy paper, about 6 inches (15 cm) on a side
- A pencil, two colored pencils (one for valleys, one for mountains) and a ruler
- A crane diagram from a library origami book or Origami USA

Steps

1. Fold the square in half both ways along the diagonals with valley folds, then turn it over and fold it in half both ways along the edges. Collapse it into a small square base.
2. Fold the lower edges of the top layer to the center line, fold the top triangle down, and unfold those three folds.
3. Do a petal fold: lift the bottom point of the top layer up along the creases while pressing the sides in. Turn over and repeat. This is the bird base.
4. Narrow both lower legs to the center on each side, then inside-reverse-fold them up to make the neck and tail. Reverse-fold the tip of one to make a head. Gently pull the wings down.
5. Fold a second crane and carefully unfold it flat. Trace every valley crease in one color and every mountain crease in the other. Label the center point, the diagonals, and the lines that became the neck and tail.
6. Add a key at the bottom: *blue = valley, red = mountain*.

Check your work

- My crane stands up, with neck, tail, head and wings.
- My crease-pattern diagram uses two colors and a key, with four labels.
- I can draw the diagram signs for valley fold, mountain fold and turn over.

FIELD NOTEBOOK

1. **Notebook entry: What folding taught me.** Write a paragraph about folding your crane. Which step was hardest? What happened when a crease was not sharp or exact? Use the words *valley fold*, *mountain fold* and *base*.
2. Draw a small chart of diagram signs: dashed line, dash-and-dot line, turn-over arrow, fold-and-unfold arrow. Write what each means.

Did you know? If you could fold an ordinary sheet of paper in half 42 times, the stack would reach past the Moon. That is the power of doubling: the thickness grows to 2^{42} layers, more than 4 trillion.

Map or diagram. Your crease-pattern drawing is a true map of the model. Origami designers today often design new animals by drawing the crease pattern first and then folding it.

Goes deeper in. Arithmetic, “Geometry: Shapes and Angles” and “Doubling and Powers of Two,” and Art, “Design and Symmetry” (coming soon).

For families. Sources: Origami USA; British Origami Society history pages; Guinness World Records (Gallivan, 27 January 2002). The early history of paper folding in China and Japan is not well recorded, so the stop avoids exact early dates. The diagram system is usually called the Yoshizawa–Randlett system, after Akira Yoshizawa and the American writer Samuel Randlett, with Robert Harbin also important. The 42-fold Moon figure assumes paper about 0.1 mm thick.

PRACTICE

1. **EASY** What do the two parts of the word *origami* mean?
2. **EASY** In an origami diagram, which kind of line shows a valley fold, and which shows a mountain fold?
3. **MEDIUM** What is the oldest known book of recreational paper folding, and what year was it printed?
4. **MEDIUM** How many layers thick is a sheet folded in half 5 times?
5. **CHALLENGE** A sheet of paper is 0.1 mm thick. How thick is the stack after 10 folds in half? Give your answer in millimeters and centimeters.

Make it a game • Diagram Relay. Players sit in a line, each with a square of paper. The first player draws one fold on a card using the diagram signs (for example, a dashed diagonal) and passes it on. Each player folds what the card says and adds the next step. At the end, unfold and compare: did everyone’s paper match? Talk about which signs were clear and which caused mistakes.

Scripture. “He that is faithful in that which is least is faithful also in much: and he that is unjust in the least is unjust also in much.” (Luke 16:10, KJV)

In origami, a small careless crease spoils the whole model. Jesus taught that faithfulness in small things shows itself in great things too. Fold carefully, even when no one is watching.

Practice: answers

1. *Ori* means “fold” and *kami* means “paper.”
2. A dashed line is a valley fold; a dash-and-dot line is a mountain fold.
3. *Hidden Senbazuru Orikata* (The Secret of Folding a Thousand Cranes), printed in Kyoto in 1797.
4. 32 layers ($2 \times 2 \times 2 \times 2 \times 2$).
5. $2^{10} = 1,024$ layers $\times 0.1$ mm = 102.4 mm, or about 10.2 cm.

3.3 HAND-LETTERING AND CALLIGRAPHY

OBJECTIVES

- Name five great families of Western handwriting and put them in order: Roman capitals, uncial, Carolingian minuscule, blackletter and italic or round hand.
- Use guidelines, a steady pen angle and nib-width measuring to letter a short verse.
- Explain how writing tools (reed, quill, steel nib) shaped the letters people made.

Warm-up. Tape two pencils together side by side with a rubber band so their points touch the paper together. Write your name. Notice how the lines are thick in some directions and thin in others, just as with a broad calligraphy pen.

Video slot. Video coming. Beginning italic calligraphy with a broad-edge pen or double pencils: pen angle, guidelines and basic strokes. Search approved channels (a public library or museum channel, the British Library, the Getty Museum); preview first.

KEY TERMS

calligraphy

The art of beautiful handwriting, from Greek words meaning “beautiful writing.” Each letter is written in a set order of pen strokes.

broad-edge pen

A pen with a flat, chisel-shaped tip. Held at a steady angle, it makes thick and thin strokes on its own.

minuscule

A small or lowercase letter. Capital letters are called majuscules.

x-height

The height of the body of a lowercase letter, like x, a or o, not counting parts that stick up or down.

ascender and descender

The parts of lowercase letters that rise above the x-height (as in b, d, h) or drop below the baseline (as in g, p, y).

CORE IDEAS

Our alphabet came to us from the Romans, who carved beautiful capital letters in stone. The finest are on the base of **Trajan’s Column** in Rome, finished in AD 113. Letter carvers first painted the letters with a flat brush, and the brush gave the letters their thick and thin parts. Roman scribes writing on papyrus and parchment used rounder, quicker forms. By the 300s, Christian scribes copying the Scriptures often used **uncial**, a round, upright capital hand that was easy to read.

As the Roman Empire fell apart in the West, every region drifted into its own crowded handwriting, and books became hard to read. Around 800, the emperor **Charlemagne**, with the English scholar **Alcuin of York** at his court, encouraged a clear, even script called **Carolingian minuscule**. It had separate words, round small letters and capitals only at the start of sentences. Most of the lowercase letters you read today descend from it.

In the later Middle Ages, scribes squeezed letters into tall, narrow, angular shapes to save costly parchment. This **blackletter** or Gothic hand looks like a dark woven fence; Gutenberg copied it for his printed Bible in the 1450s. Italian scholars of the 1400s went back to old Carolingian books for a cleaner model. Their quick, slanted version became **italic**, and in 1522 the papal scribe Ludovico degli Arrighi printed the first copybook teaching it.

Tools shaped letters. Reeds and later goose **quills**, cut to a flat edge, made thick and thin lines by their angle. In the 1700s writing masters used finely pointed quills that spread under pressure, producing the flowing English **round hand**, or copperplate. George Bickham engraved the work of London's leading penmen on about two hundred copper plates for *The Universal Penman*, issued in 52 parts from 1733 to 1741. In the 1800s, factories in Birmingham, England, turned out millions of cheap steel nibs, and in America Platt Rogers Spencer's Spencerian script was taught in schools and offices. In 1906 Edward Johnston's book *Writing & Illuminating, & Lettering* revived the broad-edge pen for modern artists.

Good lettering depends on a few rules. Rule light pencil **guidelines**: a baseline, an **x-height** line, and lines for **ascenders** and descenders. Calligraphers measure the x-height in pen widths; italic is often 5 nib widths tall. Hold the pen at one steady angle, about 45° for italic, and let the edge make the thick and thin strokes. Keep letters leaning at the same slope, and keep the spaces inside and between letters even. **Hand-lettering** is a looser cousin: drawing letters, often with a pencil outline that is then filled in, for signs and cards.

PICTURE STUDY

A plate from The Universal Penman, George Bickham the Elder (engraver), after London writing masters, 1733–1741 · Engraving on paper · Copies in many libraries, including the Morgan Library, New York, and the British Library, London

George Bickham (1684–1758) was a writing master and an engraver in London. He gathered samples of handwriting from the leading penmen of his day, engraved them on copper plates, and sold them as a copybook in weekly parts. Clerks, merchants and schoolchildren copied its pages for a hundred years. Many plates carry proverbs and moral lessons, so a student practiced good writing and good sayings at the same time.

Look closely

- Find the thickest and thinnest lines in one word. Where does the pen press hardest?
- Find a large flourish. Does it ever cross over the words?
- Find the slope of the letters. Is it the same all the way across?

Talk about it

1. Why would merchants and clerks in the 1700s need beautiful, even handwriting?
2. This hand was made with a pointed pen. How do its thick and thin strokes differ from italic made with a broad edge?

HANDS-ON: LETTER A VERSE IN ITALIC

Rule your own guidelines, practice basic italic strokes, and letter Psalm 45:1 (or another short verse) for your notebook.

You will need

- A calligraphy marker with a chisel tip (about 3.5 mm), or two pencils taped together
- Smooth paper and a sheet of practice paper
- A ruler and a sharp pencil
- An italic alphabet from a library book or printed exemplar

Steps

1. Hold the pen at 45° and make a little ladder of short flat squares down the margin, five nib widths tall. This is your x-height. Ascenders and descenders get about 3 or 4 more widths each.
2. Rule light pencil lines: ascender line, x-height line, baseline and descender line, then repeat for each line of writing.
3. Practice the basic strokes: a straight down stroke, the “n” arch that springs from the stem, and the “a/o” bowl. Fill a line of each.
4. Practice the letters of your verse, keeping the slope steady (about 5° to the right).
5. Letter the verse on good paper. Add a larger capital at the start. When the ink is dry, erase the pencil lines gently.
6. Draw a diagram beside it: one large lowercase *h* and *g* on four guidelines, labelled *ascender line*, *x-height*, *baseline*, *descender line*, *ascender*, *descender* and *pen angle 45°*.

Check your work

- My guidelines are measured in nib widths and ruled lightly.
- My letters keep the same height, slope and pen angle.
- My diagram has seven labels.

FIELD NOTEBOOK

1. **Notebook entry: A short history of letters.** Write a paragraph tracing our letters from Roman capitals to modern handwriting. Name at least three scripts and one person, with a date.
2. Write the word *minim* in the five scripts you learned about, copying from library examples, and label each.

Did you know? The word *uncial* may come from the Latin word for “inch,” perhaps because the letters were large. Medieval scribes sometimes wrote little notes in the margins, such as “Thank God it will soon be dark,” and “My hand is weary.”

Map or diagram. Your letter diagram is how type designers still plan fonts: every letter of a typeface is drawn on the same set of lines so that the letters look like a family.

Goes deeper in. History, “Charlemagne” and “The Middle Ages,” and Art, “Lettering and Illumination” (coming soon).

For families. Sources: British Library, “Western Manuscript Scripts”; Morgan Library and Wikipedia on George Bickham; Edward Johnston Foundation. Pen widths and angles vary between teachers; 5 nib widths and about 45° are common starting points for italic. The margin notes are well known from medieval manuscripts but the exact wording differs in translation. Left-handed students may need a left-oblique nib or to turn the paper; let them find a comfortable angle.

PRACTICE

1. **EASY** Where can you see some of the finest Roman capital letters, and when was it finished?
2. **EASY** What is the x-height of a letter?
3. **MEDIUM** Who encouraged Carolingian minuscule, and why does it matter to us today?
4. **MEDIUM** Why did blackletter scribes make their letters tall and narrow?
5. **CHALLENGE** Your pen nib is 3.5 mm wide. Italic x-height is 5 nib widths and ascenders add 3 more. How far apart are the baseline and x-height line, and how tall is a letter *h*?

Make it a game • Name That Hand. Print or copy from library books one word in five scripts: Roman capitals, uncial, Carolingian, blackletter and italic. Cut them apart, shuffle, and race to lay them in order from oldest to newest. For a second round, a player writes a mystery letter in one script and the others guess which family it belongs to.

Scripture. “My heart is inditing a good matter: I speak of the things which I have made touching the king: my tongue is the pen of a ready writer.” (Psalm 45:1, KJV)

“Inditing” means overflowing or composing. The psalmist compares his tongue to a skilled scribe’s pen, ready to write words worthy of the King. Letter something worthy of being written beautifully.

Practice: answers

1. On the base of Trajan’s Column in Rome, finished in AD 113.
2. The height of the body of a lowercase letter, such as x, a or o, not counting ascenders or descenders.

3. Charlemagne, with the scholar Alcuin of York, around 800. Most of our lowercase letters descend from it.
4. To fit more words on each page and save expensive parchment.
5. x-height: $5 \times 3.5 = 17.5$ mm. An h is $5 + 3 = 8$ nib widths: $8 \times 3.5 = 28$ mm.

3.4 CARDS AND STATIONERY

OBJECTIVES

- Tell how the Penny Post of 1840 and the first Christmas card of 1843 made sending cards a common habit.
- Choose paper by weight and grain, and score and fold a card that fits a standard envelope.
- Design and make a matching set of stationery: a folded card, an envelope and a note sheet.

Warm-up. Find a greeting card or letter your family has kept for a long time. Why do you think it was saved? Look at the paper: is it thicker than printer paper? Is there anything special about how it is printed or folded?

Video slot. Video coming. History of the Penny Black and the Penny Post; how to score and fold cardstock for a handmade card. Search approved channels (Smithsonian National Postal Museum, the Postal Museum London, a public library craft channel); preview first.

KEY TERMS

stationery

Writing paper, cards and envelopes, often made as a matching set. (Spelled with an *e*; *stationary* with an *a* means “standing still.”)

cardstock

Thick, stiff paper used for cards. In the United States it is often sold as 65 lb or 110 lb “cover” stock; elsewhere by grams per square meter (gsm).

grain

The direction most of the fibers in a sheet of machine-made paper lie. Paper folds smoothly along the grain and cracks when folded against it.

score

To press a straight dent into paper with a blunt tool before folding, so the fold is crisp and does not crack.

postage

The fee paid to carry mail, usually shown by a stamp.

CORE IDEAS

For most of history, sending a letter was costly. In Britain before 1840, the person who *received* a letter paid, and the price depended on the distance and the number of sheets. A single sheet from London to Edinburgh could cost more than a shilling, close to a day’s wages for a laborer. People wrote across the page and then turned it sideways to write again,

crosswise, to save paper, and they folded the sheet into its own envelope, because a separate envelope counted as a second sheet.

A schoolmaster and reformer named **Rowland Hill** argued that a low, flat rate paid in advance would bring in so many more letters that the Post Office would still make money. Parliament agreed. From January 1840, a letter of up to half an ounce went anywhere in Britain for one penny, and on 1 May 1840 the world's first adhesive postage stamp, the **Penny Black**, went on sale, showing young Queen Victoria. The number of letters mailed in Britain more than doubled in the first year. The United States issued its first stamps in 1847.

Cheap postage made cards possible. In 1843 **Henry Cole**, a busy London civil servant who helped Rowland Hill, had too many friends to write Christmas letters to. He asked the artist **John Callcott Horsley** to design a printed card with a greeting, "A Merry Christmas and a Happy New Year to You," and about a thousand copies were printed and hand-colored. It is called the first commercial Christmas card. In the 1870s **Louis Prang**, a German-born printer in Boston, began selling richly colored Christmas cards made by lithography, and Americans took up the custom.

Making good cards starts with the paper. **Cardstock** is heavier than copy paper: printer paper is about 75 to 90 grams per square meter, and card is about 200 to 300. Machine-made paper has a **grain**. To find it, bend a sheet gently both ways; it bends more easily along the grain. Fold with the grain, and always **score** heavy paper first: lay a ruler on the fold line and press a groove with a bone folder or an empty ballpoint pen.

Plan sizes before you cut. A sheet of letter paper ($8\frac{1}{2} \times 11$ inches) cut in half gives two $5\frac{1}{2} \times 8\frac{1}{2}$ pieces; folded, each makes a card $4\frac{1}{4} \times 5\frac{1}{2}$ inches, called an A2 card, which fits an A2 envelope ($4\frac{3}{8} \times 5\frac{3}{4}$). The U.S. Postal Service will not take a letter smaller than $3\frac{1}{2} \times 5$ inches, and square envelopes cost extra because sorting machines cannot handle them. A matching set of **stationery**, with the same color, border or small emblem on the card, the note paper and the envelope, looks thoughtful and orderly. Most important of all is what you write inside.

PICTURE STUDY



Woman Writing a Letter, Gerard ter Borch, c. 1655 · Oil on panel · Mauritshuis, The Hague, Netherlands
Wikimedia Commons · Public domain

Gerard ter Borch (1617–1681) was a Dutch painter famous for quiet scenes of people reading and writing letters and for painting satin and silk so well you can almost feel them. The Dutch Republic had one of the best postal systems of its day, and letter-writing was a common subject for Dutch artists. This painting is small, only about 15 by 11 inches.

Look closely

- Find the quill pen. How is she holding it?
- Find the sheet of paper. Is it large or small? Can you see any writing?
- Look at the light. Where does it fall most brightly?

Talk about it

1. How does the painter show that writing a letter takes care and attention?
2. What would she have done with the letter after writing it, in a time before envelopes were common?

HANDS-ON: A MATCHING STATIONERY SET

Design a small emblem or border and use it on a folded card, a note sheet and a hand-folded envelope. Then write a real letter to someone who would be glad to hear from you.

You will need

- Cardstock (65 lb or heavier) and plain writing paper
- A ruler, pencil, scissors or paper trimmer, and a bone folder or empty ballpoint pen

- Glue stick, colored pencils or fine markers
- An A2 envelope to use as a pattern, or a sheet of paper to fold one

Steps

1. Find the grain of your cardstock by bending it gently each way.
2. Cut a piece $5\frac{1}{2} \times 8\frac{1}{2}$ inches. Measure $4\frac{1}{4}$ inches from one end, score along the ruler, and fold. The fold should run with the grain.
3. Design a small emblem (your initial, a flower or a cross) and a simple border. Draw it on the card front, at the top of a note sheet cut to 4×5 inches, and on the envelope flap.
4. Make an envelope: unfold a store envelope to use as a pattern, trace it onto paper, cut, fold and glue the side flaps. Check that your card slides in with a little room.
5. Draw a layout diagram on graph paper: the $8\frac{1}{2} \times 11$ sheet with lines showing where you cut and where you fold, every measurement labelled, and an arrow marked *grain*.
6. Write a short letter or note inside the card and send or give it.

Check your work

- My card is scored and folds cleanly with the grain.
- The card fits the envelope, and all three pieces share one design.
- My layout diagram shows cut lines, fold lines, measurements and grain direction.

FIELD NOTEBOOK

1. **Notebook entry: Why the Penny Post mattered.** Write a paragraph explaining how mail worked before 1840 and what changed afterward. Use the names Rowland Hill and Henry Cole and at least two dates.
2. Paste in a used postage stamp, or draw one, and write its country, value and picture beside it.

Did you know? The Penny Black was printed in sheets of 240 stamps, because there were 240 pennies in a British pound. About 68 million were printed in less than a year. They were soon replaced by the Penny Red, because a red cancellation mark was hard to see on a black stamp.

Map or diagram. Your layout diagram is the kind a printer makes before cutting. Laying out several cards on one large sheet so nothing is wasted is called “imposition.”

Goes deeper in. History, “Victorian Britain,” Arithmetic, “Measurement and Fractions,” and Small Business & Economics, “Costs and Prices” (coming soon).

For families. Sources: The Postal Museum, London; Smithsonian National Postal Museum; Victoria and Albert Museum on the 1843 Cole-Horsley card. Pre-1840 postage rates varied with distance and the number of sheets; the London-Edinburgh figure is given only as “more than a shilling.” The first-year growth in letters is reported in slightly

different figures by different sources. If your child wants to sell cards, see Trail D first; any real selling needs a parent's sign-off. Envelope size rules are those of the U.S. Postal Service as of this writing and may change.

PRACTICE

1. **EASY** What was the Penny Black, and when did it go on sale?
2. **EASY** Who sent the first commercial Christmas card, and in what year?
3. **MEDIUM** Why should you score cardstock before folding it, and which way should the fold run?
4. **MEDIUM** Before 1840, why did people fold a letter into its own envelope instead of using a separate one?
5. **CHALLENGE** You want 12 A2 cards. Each letter sheet ($8\frac{1}{2} \times 11$) makes 2 cards. Cardstock costs \$0.15 a sheet and envelopes \$0.10 each. What is the cost of cardstock and envelopes for 12 cards?

Make it a game • Post Office. Set up a family post office with a box for each person. During the week, everyone writes at least three short notes or cards to others in the house, "stamps" them with a drawn stamp, and posts them. One player is postmaster and delivers the mail at dinner. Anyone who receives mail must write back.

Scripture. "A word fitly spoken is like apples of gold in pictures of silver." (Proverbs 25:11, KJV)

A well-chosen word, said at the right time, is as precious as gold set in silver. A handmade card is the silver setting; the kind and true words you write inside are the gold.

Practice: answers

1. The world's first adhesive postage stamp, sold in Britain from 1 May 1840.
2. Henry Cole, in 1843, with a design by John Callcott Horsley.
3. Scoring makes a crisp fold that does not crack; the fold should run with (parallel to) the grain.
4. Because postage was charged by the sheet, and a separate envelope counted as an extra sheet, doubling the cost.
5. $12 \div 2 = 6$ sheets $\times$ \$0.15 = \$0.90. 12 envelopes $\times$ \$0.10 = \$1.20. Total \$2.10.

3.5 PAPER QUILLING

OBJECTIVES

- Tell the history of paper filigree from gilded book trimmings to the quillwork sconces of colonial Boston.
- Roll and shape at least eight basic quilling forms: tight coil, loose coil, teardrop, marquise, square, triangle, heart and scroll.
- Plan a quilled design on a labelled sketch before gluing.

Warm-up. Wrap a strip of paper tightly around a pencil, slide it off, and let go. Watch what happens. Now try a thinner strip and a thicker one. Which holds its curl best? Why do you think so?

Video slot. Video coming. Paper quilling for beginners: rolling coils with a slotted tool and pinching basic shapes (teardrop, marquise, scroll). Search approved channels (a public library or museum craft channel, the Metropolitan Museum of Art); preview first.

KEY TERMS

quilling

The craft of rolling narrow strips of paper into coils and pinching them into shapes, then gluing them together into designs. Also called paper filigree or paper rolling.

filigree

Delicate lacy ornament, first made of fine twisted gold or silver wire. Paper filigree imitated it.

coil

A strip of paper rolled into a spiral. A tight coil is glued at once; a loose coil is let go to open up before the end is glued.

slotted tool

A quilling tool with a thin split at the tip that grips the end of the strip so it can be turned into a coil.

marquise

An eye- or leaf-shaped quilled form made by pinching a loose coil at two opposite points.

CORE IDEAS

Quilling began as an imitation of something costly. Goldsmiths made **filigree**, lacy ornament of fine twisted gold and silver wire. In the 1500s and 1600s, according to most accounts, nuns and other religious workers in France and Italy found a cheaper way to get the same look. Fine books had their page edges gilded, and when bookbinders trimmed or repaired them, thin strips of paper with one golden edge were left over. Rolled tightly and set on

edge, the strips glittered like metal. They were used to frame holy pictures and decorate reliquaries.

The name probably comes from rolling the paper around a bird's **quill** (the hollow shaft of a feather). In the 1700s paper filigree became a fashionable craft in England. Girls and young women at boarding schools learned it alongside needlework, and filled tea caddies, work boxes, picture frames, fire screens and even cabinets with thousands of tiny coils, often painted or gilded at the edges. A large piece might hold tens of thousands of rolls and take months.

The craft crossed the Atlantic. In colonial Boston in the 1720s to 1740s, girls at schools for young ladies made **quillwork sconces**: shallow framed boxes filled with flowers and leaves of rolled paper, sprinkled with sparkling mica and wax fruit, with a candle arm on the front. At night the candlelight shimmered across the coils. Only a few dozen survive; nearly all were made in or near Boston, and museums such as the Metropolitan Museum of Art and Winterthur treasure them. (Do not confuse this with the **porcupine quillwork** of North American Indians, a different craft that uses flattened, dyed quills sewn onto hide and bark.)

Quilling today uses the same few movements. A strip, usually 1/8 inch (3 mm) wide, is slipped into a **slotted tool** and turned to make a **coil**. A **tight coil** is glued while still wound, like a little button. A **loose coil** is let go first so it relaxes into a wider spiral, and then glued. Pinch a loose coil at one point and you have a **teardrop**; pinch two opposite points for a **marquise** or leaf; pinch four for a square or diamond; three for a triangle. Roll each end of an unglued strip toward the middle for an S-scroll or a heart.

Good quilling is a matter of consistency. Strips torn rather than cut have soft ends that hide when glued. Coils made from the same length and let go in the same way come out the same size, so the petals of a flower match. Use glue sparingly: one tiny dot, put on with a pin. Work on a plan drawn first, and glue shapes edge-to-edge, standing up, so the design is seen from above like a jewel.

PICTURE STUDY



Quillwork Sconce, Attributed to Eunice Deering, Kittery, Maine, 1720–1740 · Rolled paper, mica and other materials in a glazed wooden shadow box, with a candle arm · The Metropolitan Museum of Art, New York (American Wing)

Wikimedia Commons · CC0

This sconce was made in New England in the early 1700s, when a candle sconce was both a light and a show of skill. The flowers and leaves are built from hundreds of rolled paper coils set on edge. Behind them, flakes of mica caught the candle's light. The Met records this piece with the name of a young woman of Kittery, Maine, believed to have made it while at school.

Look closely

- Find a flower. How many coils make up one petal?
- Find a leaf. Is it a pinched shape (a marquise) or something else?
- Look for anything that sparkles. Where would the candle have been?

Talk about it

1. Why would a candle make this quillwork look different at night than in the day?
2. What does a piece like this tell you about the patience and training of the young woman who made it?

HANDS-ON: QUILLED SHAPE SAMPLER AND FLOWER CARD

Make a labelled sampler of eight quilled shapes, then plan and build a small quilled flower to mount on a card or bookmark.

You will need

- Quilling strips 1/8 inch (3 mm) wide, or strips cut from colored paper with a ruler and craft knife (with a grown-up)
- A slotted quilling tool, or a round toothpick with a slit cut in the end
- White craft glue on a scrap lid, and a pin to apply it
- A piece of cardstock and a pencil
- A circle template or a coin for sizing coils (optional)

Steps

1. Make one of each: tight coil, loose coil, teardrop, marquise, square, triangle, heart and S-scroll. Use strips of the same length (about 8 inches) for all loose shapes.
2. Glue them in two rows on a piece of cardstock. Write the name of each shape under it.
3. On another sheet, draw a plan of a flower: a tight-coil center, five or six teardrop petals, a scroll stem and two marquise leaves. Label each part with its shape name and strip length.
4. Roll the pieces for your flower. Check that the petals are the same size before gluing.
5. Glue the flower onto a folded card or a bookmark, petals standing on edge, one tiny dot of glue each.
6. Count and record how many coils and how many inches of strip you used in all.

Check your work

- My sampler has eight labelled shapes.
- My flower plan names each part and its strip length.
- My petals match in size, and no glue shows.

FIELD NOTEBOOK

1. **Notebook entry: Gold from scraps.** Write a paragraph telling how paper filigree began from gilded book trimmings and how it came to colonial Boston. End with one sentence about something useful you could make from what others throw away.
2. Draw and label the eight basic shapes in a grid, with a tiny arrow showing where each is pinched.

Did you know? Quillers often store strips by color and length, because a coil's size depends on both length and how tightly it is let go. Wider strips, 1/4 or 3/8 inch, are snipped along one edge and rolled up to make fluffy fringed flowers like dandelions and asters. Some English filigree pieces of the 1700s were made from strips with gilded or colored edges, so only a thin line of gold showed.

Map or diagram. Your flower plan is a working drawing. Craftsmen in every trade, from cabinetmakers to quillers, draw the plan before cutting or gluing, so they can fix mistakes in pencil instead of in material.

Goes deeper in. Art, “Pattern and Design,” and History, “Colonial America” (coming soon).

For families. Sources: The Metropolitan Museum of Art, “Quillwork Sconce” records; Winterthur Museum; Victoria and Albert Museum (paper filigree tea caddies); Galt Museum, “Quilling and Culture.” The early history of quilling by French and Italian religious houses is widely repeated but not well documented, so it is told “according to most accounts.” The Met holds several American quillwork sconces; the attribution to Eunice Deering follows the museum’s record and may be described differently on its page.

PRACTICE

1. **EASY** What expensive craft did paper filigree imitate?
2. **EASY** What is the difference between a tight coil and a loose coil?
3. **MEDIUM** How do you make a marquise, and what does it often represent in a design?
4. **MEDIUM** Where were nearly all surviving American quillwork sconces made, and when?
5. **CHALLENGE** Your flower uses 6 petals of 8 inches, 1 center of 12 inches, 2 leaves of 6 inches and a stem of 5 inches. Strips come 24 inches long. How many inches do you need, and how many strips (if you can piece leftovers)?

Make it a game • Shape Call. Each player has a stack of loose coils. The caller names a shape (“teardrop!” “square!” “marquise!”) and everyone pinches one as fast as they can and holds it up. The caller judges whose is neatest, not fastest. After ten calls, glue the best of each shape onto a group sampler.

Scripture. “Seest thou a man diligent in his business? he shall stand before kings; he shall not stand before mean men.” (Proverbs 22:29, KJV)

“Mean” here means common or lowly. Patient, careful work is noticed and honored. A quiller who rolls a thousand coils well is learning diligence, which serves in every calling.

Practice: answers

1. Metal filigree: lacy ornament made of fine twisted gold or silver wire.
2. A tight coil is glued while still tightly wound; a loose coil is let go to relax and open up, then glued.
3. Pinch a loose coil at two opposite points. It often makes a leaf or an eye shape.
4. In or near Boston, mostly between about 1720 and 1740.
5. $48 + 12 + 12 + 5 = 77$ inches. $77 \div 24 = 3$ with 5 left over, so you need 4 strips.

3.6 PRESSED-FLOWER BOOKMARKS

OBJECTIVES

- Explain how pressing dries a flower and why some flowers press better than others.
- Tell how botanists, from Luca Ghini to young Emily Dickinson, kept pressed plants in herbaria.
- Press, label and seal flowers into a bookmark, and make a labelled specimen sheet.

Warm-up. Pick (with permission) one thin flower, like a pansy or violet, and one thick one, like a marigold or rosebud. Squeeze each gently. Which feels wetter and thicker? Predict which will press flat and keep its color better.

Video slot. Video coming. How to press flowers with books and blotting paper; how a botanist mounts a herbarium specimen. Search approved channels (a botanical garden such as Missouri Botanical Garden or Kew, a university herbarium, a public library craft channel); preview first.

KEY TERMS

herbarium

A collection of dried, pressed plants mounted on sheets and labelled, kept for study (plural: herbaria).

specimen

One plant or part of a plant collected as an example of its kind.

blotting paper

Soft, thick, absorbent paper that draws water out of flowers as they press.

botanist

A scientist who studies plants.

label

On a specimen sheet, the written record of the plant's name, where and when it was collected, and who collected it.

CORE IDEAS

A fresh flower is mostly water, often 80 to 90 percent. Left in the air, it shrivels as the water leaves, and it curls and browns. **Pressing** holds the petals flat while absorbent paper draws the water out quickly, so the flower dries in its open shape and keeps much of its color. Thin, flat flowers with little water, such as pansies, violets, larkspur, cosmos, Queen Anne's lace and ferns, press best. Thick, fleshy or many-layered flowers, such as roses and marigolds, need to be taken apart into petals first.

Pressed plants began as science. In the 1500s, the Italian professor **Luca Ghini** of Bologna and Pisa is credited with being among the first to dry plants between paper and glue them to sheets, so his students could study them in winter. These collections were called a *hortus siccus*, a “dry garden,” and later a **herbarium**. The Swedish botanist **Carl Linnaeus** (1707–1778), who gave plants their two-part Latin names, kept thousands of pressed **specimens**; his herbarium is still kept in London. Today the world’s herbaria hold hundreds of millions of sheets, and scientists still use them to identify plants and see where they grew long ago.

Pressing was also a common schoolroom craft. In the 1840s, a girl of about fourteen in Amherst, Massachusetts, named **Emily Dickinson** gathered 424 plants from woods, fields and gardens, pressed them, and arranged them on the 66 pages of an album, labelling most with their Latin names. She later became one of America’s best-known poets. Her herbarium is kept at Harvard University and can be seen online.

An English botanist, **Anna Atkins** (1799–1871), found a new use for pressed plants. In 1843 she began publishing *Photographs of British Algae*, laying pressed seaweeds directly on paper coated with chemicals that turn blue in sunlight. Where the plant covered the paper it stayed white. The result, called a **cyanotype**, made it one of the first books ever illustrated with photographs.

To press flowers at home, pick them on a dry day after the dew is gone, and only where you have permission. Lay them face down on **blotting paper** or plain paper (not paper towels, which leave a texture), cover with another sheet, and close them in a heavy book with more books on top. Change the paper after three or four days. Most flowers are ready in one to three weeks, when they feel papery and stiff. A careful presser always makes a **label**: what the plant is, where and when it was found, and who found it. Without a label, a pressed flower is pretty; with one, it is also a record.

PICTURE STUDY



*A plate from Photographs of British Algae: Cyanotype Impressions, Anna Atkins, 1843–1853 · Cyanotype (sun print) on paper, made from a pressed specimen · Copies at the British Library, the Natural History Museum (London) and the New York Public Library
Wikimedia Commons · Public domain*

Anna Atkins was the daughter of a scientist and an expert collector of plants. When the cyanotype process was invented by her family friend Sir John Herschel in 1842, she saw at once that it could show pressed plants more exactly than any drawing. She made her book by hand, page after page, over ten years, and only a handful of copies were made.

Look closely

- Find the finest branch tip. How thin is it?
- Find the label. Is it written by hand or printed?
- Look at the edges of the white shape. Are they sharp or soft? Why might that be?

Talk about it

1. Why would a scientist want a picture made by the plant itself instead of a drawing?
2. How is a cyanotype like a pressed-flower bookmark, and how is it different?

Safety first. Pick flowers only with permission and never in parks or nature preserves, where it is often against the rules. Learn to recognize poison ivy and do not pick plants you cannot name; some garden flowers, like foxglove and lily of the valley, are poisonous. Wash your hands after handling plants, and keep pressed flowers away from small children and pets.

HANDS-ON: PRESSED-FLOWER BOOKMARKS AND A SPECIMEN SHEET

Press several flowers, mount one as a proper herbarium specimen with a label, and seal others into bookmarks to keep or give.

You will need

- Flowers and leaves picked with permission (pansies, violets, ferns, small daisies or petals pulled from larger flowers)
- Blotting paper or plain printer paper, and several heavy books
- Cardstock cut into 2 × 6 inch strips, and one sheet for a specimen page
- Clear self-adhesive contact paper or a laminating pouch (laminating with a grown-up)
- Tweezers, a fine pen, glue and a hole punch with ribbon

Steps

1. Press your flowers face down between paper inside a heavy book. Write the date on the page edge. Change the paper after 3 or 4 days.
2. After one to three weeks, lift the flowers out with tweezers.
3. Specimen sheet: glue one complete plant (with stem and leaves if possible) to the cardstock. In the lower right corner write a label: common name, Latin name if you can find it, where found, date, collector. Draw a small diagram beside it labelling *petal*, *sepal*, *stem*, *leaf* and *center*.
4. Bookmark: arrange flowers on a cardstock strip with tiny dots of glue. Write a short verse or the flower's name at the bottom.
5. Cover both sides with clear contact paper, smoothing from the middle out to push out air. Trim the edges, leaving a small clear border.
6. Punch a hole at the top and tie on a ribbon.

Check your work

- My flowers are fully dry, flat and not moldy.
- My specimen sheet has a full label and a diagram with five parts named.
- My bookmark is sealed with no air bubbles over the flowers.

FIELD NOTEBOOK

1. **Notebook entry: Why press a flower?** Write a paragraph explaining how pressing works and why scientists keep herbaria. Mention Luca Ghini, Linnaeus or Emily Dickinson.
2. Keep a pressing log: flower, date pressed, date ready, how well it kept its color (good, fair, poor). Which colors lasted best?

Did you know? Blue and purple flowers, like larkspur and violets, often keep their color well when pressed, while white flowers can turn cream or brown. Red flowers often darken. Keeping pressed flowers out of direct sunlight helps the colors last for years.

Map or diagram. A herbarium label works like a map pin: it records exactly where a plant grew. Botanists today often add the latitude and longitude, so someone could find the same spot a century later.

Goes deeper in. Life Science, “Plants and Flowers,” Gardening & Animals, “A Flower Garden,” and Literature, “American Poets” (coming soon).

For families. Sources: Harvard’s Houghton Library (Emily Dickinson Herbarium, 66 leaves, 424 specimens); the Linnean Society of London; the British Library and the New York Public Library on Anna Atkins. Luca Ghini (c. 1490–1556) is usually credited with the first herbarium, though his own collection does not survive; the stop says “among the first.” Whether Atkins’s book was the very first illustrated with photographs is debated (Fox Talbot’s *The Pencil of Nature* appeared in 1844–1846, while Atkins’s first part was 1843), so the stop says “one of the first.” The water figure of 80 to 90 percent is typical for soft flowers; it varies by plant.

PRACTICE

1. **EASY** What is a herbarium?
2. **EASY** Name two flowers that press well and one that should be taken apart first.
3. **MEDIUM** What four things belong on a specimen label?
4. **MEDIUM** How did Anna Atkins make pictures of her pressed plants?
5. **CHALLENGE** A flower weighs 2.0 grams fresh and 0.3 grams pressed and dry. What percent of its weight was water?

Make it a game • Botanist’s Walk. Take a walk in your yard or a field where you have permission. Each player tries to find, without picking, ten different flowering plants and name or describe each in a notebook. Score 1 point for a description, 2 for a correct common name, and 3 for a correct Latin name checked in a field guide at home.

Scripture. “And why take ye thought for raiment? Consider the lilies of the field, how they grow; they toil not, neither do they spin: And yet I say unto you, That even Solomon in all his glory was not arrayed like one of these.” (Matthew 6:28–29, KJV)

Jesus told His disciples to “consider” the flowers: to look closely. Pressing and labelling a flower is a way of considering it, and of seeing how richly God clothes even the grass of the field.

Practice: answers

1. A collection of dried, pressed plants mounted on sheets and labelled for study.
2. Press well: any two of pansy, violet, larkspur, cosmos, Queen Anne’s lace, fern. Take apart first: rose or marigold.
3. The plant’s name, where it was found, when it was found, and who collected it.

4. She laid pressed specimens on paper coated with chemicals that turn blue in sunlight; the paper under the plant stayed white, making a cyanotype.
5. It lost 1.7 grams. $1.7 \div 2.0 = 0.85$, so 85 percent was water.

3.7 SIMPLE BOOKBINDING

OBJECTIVES

- Explain how the codex replaced the scroll, and why early Christians favored it.
- Use the words folio, quarto, octavo, signature and spine correctly, and work out how many pages a folded sheet makes.
- Sew a single-signature notebook with a five-hole pamphlet stitch and a card cover.

Warm-up. Take a sheet of paper and fold it in half, then in half again, then once more. Without cutting, number the pages 1 to 16 in pencil as if it were a little book. Now unfold it. Are the numbers where you expected? Bookbinders and printers have to plan this before they print.

Video slot. Video coming. How to sew a five-hole pamphlet stitch notebook; how a medieval book was bound. Search approved channels (the British Library, the Getty Museum, the Folger Shakespeare Library, a university library conservation channel); preview first.

KEY TERMS

codex

A book made of folded sheets stacked and fastened at one edge, with covers: the book shape we use today, as opposed to a scroll (plural: codices).

signature

A group of folded sheets nested together and sewn as one unit. Also called a section or gathering.

folio, quarto, octavo

A sheet folded once (2 leaves, 4 pages), twice (4 leaves, 8 pages) or three times (8 leaves, 16 pages). The words also describe book sizes.

spine

The back edge of a book where the pages are sewn and joined to the cover.

bone folder

A smooth, flat tool, once made of bone, used to press sharp creases in paper.

CORE IDEAS

The ancient world read from **scrolls**. To find a passage, you unrolled with one hand and rolled up with the other; a long book like Isaiah might fill a roll more than 20 feet long. The Romans also used wax tablets tied together, and from them came the idea of the **codex**: sheets of papyrus or parchment folded, stacked and fastened along one side. A codex could be written on both sides, held much more, and let a reader turn straight to any page.

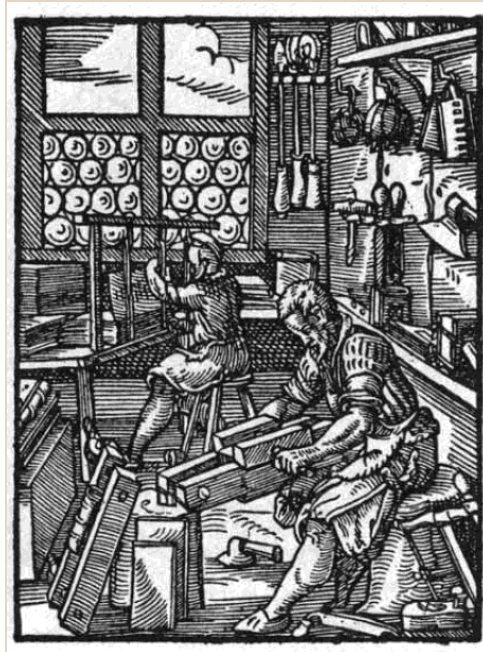
Christians were among the first to use the codex widely. Nearly all the earliest Christian manuscripts of the Scriptures that survive, from the 100s and 200s, are codices, while most other books of that time were still scrolls. A codex let a church carry the four Gospels or Paul's letters in one volume and find a text quickly. By about AD 400 the codex had become the usual form of the book. Great Bibles such as **Codex Sinaiticus**, written in the 300s, are among the treasures of the world.

The way a codex is built has hardly changed. A large sheet folded once is a **folio**, with 2 leaves and 4 pages. Folded twice it is a **quarto**, 4 leaves and 8 pages. Folded three times it is an **octavo**, 8 leaves and 16 pages. Several folded sheets nested together form a **signature**. The binder sews each signature through the fold, links the signatures to one another with a special "kettle stitch" at the head and tail, glues the **spine**, and attaches covers of wooden boards, leather or stiff card. The oldest European book still in its original binding, the **St Cuthbert Gospel**, was bound in northern England around AD 700, and its red leather cover is still attached.

For a thousand years books were bound by hand, one at a time. Monks bound books in monasteries; later, binders worked in town shops with a sewing frame, a press, knives and brass tools for stamping gold designs into leather. After the printing press, the printer and the binder were usually different tradesmen, and many buyers bought a printed book unbound and paid a binder to cover it to match their library. In the 1820s, English publishers began issuing books already bound in cloth, and by the late 1800s machines folded, sewed and cased thousands of books a day.

The simplest binding is the **pamphlet stitch**, which sews a single signature with one length of thread. Punch an odd number of holes (three or five) along the fold with an awl, then sew in and out with a needle so the thread passes through each hole and the two ends meet at the center hole, where they are tied around the long stitch. Use a **bone folder** to make crisp folds, and fold with the grain so the pages lie flat. A sewn book will last far longer than one held with staples or glue alone.

PICTURE STUDY



*The Bookbinder (Der Buchbinder), from the Book of Trades (Ständebuch), Jost Amman, with verses by Hans Sachs, 1568 · Woodcut · Copies in many collections, including the Metropolitan Museum of Art and the Herzog August Library, Wolfenbüttel
Wikimedia Commons · Public domain*

Jost Amman (1539–1591), a Swiss-born artist working in Nuremberg, cut more than a hundred small pictures of German tradesmen for a book printed in Frankfurt in 1568. Each picture has a short rhyming verse by the shoemaker-poet Hans Sachs, in which the tradesman describes his own work. The bookbinder's picture shows the main tools of the trade, many of which binders still use.

Look closely

- Find the sewing frame. What is held upright on it, and why?
- Find the press. What is being done to the book in it?
- Find finished books. How do their covers and clasps look?

Talk about it

1. Which tools in this picture would you need to make your own notebook? Which could you do without?
2. Why might a city like Nuremberg, with many printers, also need many bookbinders?

Safety first. An awl and a needle are sharp. Punch holes on a folded towel or an old phone book, never on your lap or hand, and always push the point away from your fingers. Keep the needle in a pincushion or stuck in a cork when you set it down.

HANDS-ON: SEW A PAMPHLET-STITCH NOTEBOOK

Make a 20-page notebook with a card cover, sewn with a five-hole pamphlet stitch. Draw a diagram first showing how the pages and holes are laid out.

You will need

- 5 sheets of letter paper ($8\frac{1}{2} \times 11$ inches) for pages
- 1 sheet of cardstock, the same size, for the cover
- A bone folder or the back of a spoon
- An awl or a thick pushpin, and a scrap of cardboard or old phone book for punching
- A large-eye needle and about 30 inches of waxed linen thread or strong embroidery floss
- A ruler, pencil and binder clips

Steps

1. Fold each page sheet in half the short way (to $5\frac{1}{2} \times 8\frac{1}{2}$), creasing with the bone folder. Nest the 5 sheets inside one another, then nest them inside the folded cover. You now have one signature of 10 leaves, 20 pages.
2. Make a punching guide: a strip of paper as tall as the fold. Mark 5 holes: one at the center, one $\frac{1}{2}$ inch from each end, and two halfway between. Lay it in the fold and punch through all layers from inside, with the book open on the punching pad.
3. Clip the book closed with binder clips. Start from the inside at the center hole (3), leaving a 3-inch tail. Sew in this order: out 3, in 4, out 5, in 4, out 2 (the long inside stitch passes over hole 3), in 1, out 2, in 3. Pull gently snug after each stitch, along the fold, not against it.
4. Inside, the two ends now sit at hole 3 on either side of the long stitch. Tie them in a square knot over the long stitch and trim to $\frac{1}{2}$ inch.
5. Draw a diagram of the open book seen from the inside: the fold line, holes numbered 1 to 5, and arrows showing the path of the thread in order. Label *spine*, *signature*, *cover*, *head* and *tail*.
6. Write a title and your name on the cover. Use the notebook for this track.

Check your work

- My pages are folded with sharp creases and nested evenly.
- My thread is snug and tied inside at the center hole.
- My diagram shows five numbered holes, the thread path and five labels.

FIELD NOTEBOOK

1. **Notebook entry: From scroll to codex.** Write a paragraph comparing a scroll and a codex. Give two advantages of the codex and tell why early Christians used it.
2. Draw a folding chart: a sheet folded once, twice and three times, labelled *folio*, *quarto* and *octavo*, with the number of leaves and pages for each.

Did you know? The St Cuthbert Gospel, a small copy of the Gospel of John, was placed in St Cuthbert's coffin in about 698 and found when the coffin was opened in Durham in 1104. The British Library bought it in 2012 for £9 million. It fits in the palm of your hand.

Map or diagram. Your stitch diagram is like the instructions binders print for students. Number the holes from head to tail and draw each pass of the thread as an arrow with a small number, so someone else could sew it from your drawing alone.

Goes deeper in. History, "The Early Church" and "The Middle Ages," and Literature, "How Books Are Made" (coming soon).

For families. Sources: British Library (St Cuthbert Gospel; Codex Sinaiticus); Getty Museum on medieval bookbinding; Metropolitan Museum of Art (Amman, *Ständebuch*). The Christian preference for the codex is well documented by scholars such as C. H. Roberts and T. C. Skeat, though the reasons are debated. The 20-foot figure for an Isaiah scroll is based on the Great Isaiah Scroll from Qumran, about 24 feet long. Sewing order: start inside at the center, out 3, in 4, out 5, in 4, out 2, in 1, out 2, in 3; any symmetrical order that ends at the center works.

PRACTICE

1. **EASY** What is the difference between a scroll and a codex?
2. **EASY** What is a signature in bookbinding?
3. **MEDIUM** How many leaves and pages does an octavo sheet make?
4. **MEDIUM** Give two reasons a codex was more useful than a scroll for early Christians.
5. **CHALLENGE** A book has 12 signatures, each made of 4 sheets folded once. How many pages does it have? How many if each sheet were folded as a quarto instead?

Make it a game • Find the Verse. One player holds a long paper "scroll" (strips taped end to end, with ten verses written along it) and another holds a stapled booklet with the same ten verses, one per page. A caller names a verse. Who finds it first? Swap and play again. Talk about why the codex won.

Scripture. "Then said I, Lo, I come: in the volume of the book it is written of me," (Psalm 40:7, KJV)

The Hebrew word for "volume" here means a roll, a scroll. The book of Hebrews (10:5-7) applies these words to Jesus Christ: the whole volume of Scripture speaks of Him. Whatever form the book takes, scroll or codex, its message is the same.

Practice: answers

1. A scroll is one long rolled strip; a codex is folded sheets stacked and fastened at one edge with covers, like a modern book.
2. A group of folded sheets nested together and sewn as one unit.

3. 8 leaves and 16 pages (the sheet is folded three times).
4. Any two: it could hold more (written on both sides, several books in one volume); you could turn straight to a passage; it was compact and easy to carry.
5. Folio: each sheet gives 4 pages, so $4 \text{ sheets} \times 4 = 16 \text{ pages per signature} \times 12 = 192 \text{ pages}$.
Quarto: 8 pages per sheet, $32 \text{ per signature} \times 12 = 384 \text{ pages}$.

3.8 BEADING AND SIMPLE JEWELRY

OBJECTIVES

- Tell how beads have been made and traded, from Venetian glass to the shell wampum of the Northeast.
- Use basic jewelry tools safely: open and close a jump ring, make a simple loop, and finish a strand with a crimp bead and clasp.
- Plan a bead pattern on paper, measure for a good fit, and string a bracelet or necklace.

Warm-up. Gather ten buttons or beads of two or three kinds. Lay them in a row in a repeating pattern, such as big-small-small. Now make a pattern that repeats every five beads. How many different patterns can you invent with the same beads?

Video slot. Video coming. Beginning jewelry making: opening and closing jump rings, making a simple wire loop, crimping a clasp on beading wire. Search approved channels (a public library or museum craft channel, the Corning Museum of Glass for how glass beads are made); preview first.

KEY TERMS

seed bead

A tiny, round glass bead used for weaving and stringing. Sizes are written like 11/0; the larger the number, the smaller the bead.

jump ring

A small metal ring with a split, used to join parts of jewelry. It is opened by twisting sideways, never by pulling apart.

crimp bead

A soft metal tube squeezed flat with pliers to hold beading wire in a loop at a clasp.

clasp

The fastener that opens and closes a bracelet or necklace, such as a lobster clasp or a toggle.

wampum

White and purple tube beads cut from whelk and quahog shells by Indian peoples of the northeastern coast, used in ceremonies, records and trade.

CORE IDEAS

Beads are among the oldest ornaments people have made. Archaeologists find them of shell, bone, stone, clay and metal all over the world. Scripture mentions jewelry from its earliest pages: Abraham's servant gave Rebekah a golden earring and two gold bracelets (Genesis 24:22), and the high priest's breastplate held twelve precious stones, one for each tribe of

Israel (Exodus 28:17–21). The Israelites gave their own jewelry of gold to build the tabernacle.

Glass beads were made in ancient Egypt and Mesopotamia, but the greatest bead-makers of later centuries were the **Venetians**. In 1291 the city of Venice moved its glass furnaces to the island of **Murano**, partly to protect the city from fire and partly to guard trade secrets. Venetian workers drew hot glass into long hollow canes and chopped them into tiny **seed beads**, and in the late 1400s they invented the many-layered chevron bead. Ships carried Venetian beads to Africa, India and the Americas, where they were traded for gold, ivory and furs.

Along the northeastern coast of North America, Algonquian peoples drilled small tube beads from shells: white from the whelk and purple from the quahog clam. These **wampum** beads were woven into belts that recorded agreements and were exchanged at councils and treaties. Purple beads were harder to make and worth more. Dutch and English colonists, short of coins, used wampum as money; Massachusetts accepted it for payments for some years in the 1600s. Making each bead by hand took long work, which is why it had value.

Pearls are gems made inside a living creature. When something irritates an oyster or mussel, it covers it with thin layers of shiny **nacre**, year after year. Natural pearls were so rare that a fine strand could cost as much as a house. In 1893 the Japanese inventor **Kokichi Mikimoto** succeeded in growing pearls by placing a bead inside oysters on purpose. These **cultured pearls** made pearl necklaces affordable for many families.

Simple jewelry needs only a few tools. Round-nose pliers bend wire into loops; chain-nose pliers grip; flush cutters snip wire. To open a **jump ring**, hold it with two pliers and twist one side toward you and the other away, like opening a door, so it keeps its round shape. Strands are strung on nylon-coated **beading wire** or stretch cord, and finished with a **crimp bead** and a **clasp**. Plan the fit: measure the wrist and add about $\frac{3}{4}$ inch for a bracelet. A good design is a planned pattern, and a well-made piece has no sharp ends and a clasp that holds.

PICTURE STUDY



Girl with a Pearl Earring, Johannes Vermeer, c. 1665 · Oil on canvas · Mauritshuis, The Hague, Netherlands
Wikimedia Commons · Public domain

Johannes Vermeer (1632–1675) painted this picture in Delft. It is not a portrait of a real person but a *tronie*, a Dutch study of a face in an unusual costume. The pearl is painted with only a few strokes: a bright highlight at the top and a soft reflection of her white collar underneath. When scientists studied the painting in 2018, they found the pearl has no outline and no hook to hang it from the ear: it is an illusion of light. Many scholars think a pearl that size would be too large to be real, and that it may stand for glass or polished tin.

Look closely

- Count the brushstrokes that make the pearl. Where is the brightest spot?
- Find the reflection at the bottom of the pearl. What is it reflecting?
- Look at the colors of the turban. Which colors are repeated elsewhere?

Talk about it

1. How does Vermeer make a few strokes of paint look like a round, shining pearl?
2. Why might a painter, or a jeweler, choose one large bead instead of many small ones?

Safety first. Small beads can choke babies and toddlers: work at a table away from little brothers and sisters and pets, and pick up every dropped bead. Wire ends are sharp: cut wire inside a closed hand or a bag so ends don't fly, and wear glasses if you have them. Tuck every wire end so it cannot scratch.

HANDS-ON: PLAN AND STRING A PATTERN BRACELET

Design a repeating bead pattern on paper, measure for fit, and make a bracelet finished with crimp beads and a clasp (or a stretch-cord bracelet tied with a surgeon's knot).

You will need

- Beads of two or three kinds (for example 6 mm round beads and 11/0 seed beads)
- Nylon-coated beading wire, 2 crimp beads, a clasp and 2 jump rings; or 0.7–1 mm stretch cord and a dab of clear glue
- Chain-nose pliers and flush cutters (or scissors for stretch cord)
- A tape measure, graph paper, colored pencils and a towel or bead tray to keep beads from rolling

Steps

1. Measure your wrist snugly and add $\frac{3}{4}$ inch. Write the finished length.
2. On graph paper, draw your design as a straight row, one square per bead, at true size if you can. Color it and label each bead type and size. Mark the clasp at each end. Write the repeat (for example, A-B-B-A) and count how many of each bead you need.
3. Cut wire 6 inches longer than the finished length. String a crimp bead and one half of the clasp, loop the wire back through the crimp, and squeeze it flat with chain-nose pliers.
4. String the beads in your planned pattern, checking against the drawing every few beads.
5. Finish with the second crimp and the other half of the clasp, pulling the wire snug but not stiff. Squeeze the crimp, trim the tail closely, and test the clasp.
6. If you use stretch cord instead, pre-stretch it, string the beads, and tie a surgeon's knot (an overhand knot with two wraps, then a second overhand). Add a dot of glue and hide the knot inside a bead.

Check your work

- My design drawing shows the pattern, bead names and counts.
- My bracelet fits with a little room and the clasp holds.
- There are no sharp wire ends, and the crimps are firm.

FIELD NOTEBOOK

1. **Notebook entry: What makes a bead valuable?** Write a paragraph comparing Venetian glass beads, wampum and pearls. Explain what made each valuable: rarity, skill, the labor it took, or something else.
2. Draw a world map outline. Mark Venice and Murano, the northeastern coast of North America (wampum), and Japan (cultured pearls), and draw arrows for the routes Venetian beads traveled to Africa and the Americas.

Did you know? About 18 to 20 size 11/0 seed beads fit in one inch. A beaded bag from the 1800s might hold tens of thousands of them, each sewn on separately. The word *bead* comes from the Old English *gebed*, meaning “prayer,” because beads were once used to count prayers.

Map or diagram. Your bead map shows that jewelry was big business. Beads were a trade good carried across oceans, which is why this stop links to Small Business & Economics.

Goes deeper in. Small Business & Economics, “Money and Trade,” History, “Colonial America” and “Venice and the Age of Exploration,” and Art, “Dutch Painting” (coming soon).

For families. Sources: Corning Museum of Glass (Venetian beads; Murano, 1291); Smithsonian National Museum of the American Indian (wampum); Mauritshuis, “Girl in the Spotlight” research project (2018); Mikimoto company history. Wampum’s use as currency among colonists is well documented, but the meaning of wampum belts to the peoples who made them was more than money, as the stop notes. Dates for Massachusetts’ acceptance of wampum vary by source, so no years are given. If your child sells jewelry (see Trail D), a parent must sign off first, and items for young children must not have small loose parts.

PRACTICE

1. **EASY** In seed bead sizes, which is smaller: 6/0 or 11/0?
2. **EASY** How should you open a jump ring, and why?
3. **MEDIUM** Why did Venice move its glass furnaces to Murano in 1291?
4. **MEDIUM** Why were purple wampum beads worth more than white ones?
5. **CHALLENGE** A wrist measures $6\frac{1}{4}$ inches. The clasp takes up $\frac{1}{2}$ inch. Each pattern repeat (one 6 mm bead and four seed beads) is about $\frac{1}{2}$ inch long. How many repeats do you need, and how many of each bead?

Make it a game • Pattern Detective. One player secretly strings a pattern of 12 beads that repeats (for example, red-blue-blue-white) and hides the last 4. The others look at the first 8 and race to string or draw the next 4. Score a point for each correct bead. Make patterns harder each round: repeats of 5, then growing patterns like A, AB, ABB, ABBB.

Scripture. “Again, the kingdom of heaven is like unto a merchant man, seeking goodly pearls: Who, when he had found one pearl of great price, went and sold all that he had, and bought it.” (Matthew 13:45-46, KJV)

Jesus compared the kingdom of heaven to a pearl worth more than everything a merchant owned. Beautiful jewelry is a good gift, but the One who made pearls is the treasure worth

everything.

Practice: answers

1. $11/0$. The larger the number, the smaller the bead.
2. Twist the two ends sideways, one toward you and one away, so the ring keeps its round shape. Pulling it apart bends it out of shape and weakens it.
3. To protect the city from fire and to guard the glassmakers' trade secrets.
4. They were cut from the purple part of the quahog shell, which was harder to get and harder to make, so each bead took more work.
5. Finished length $6\frac{1}{4} + \frac{3}{4} = 7$ inches. Minus $\frac{1}{2}$ inch clasp = $6\frac{1}{2}$ inches of beads. $6\frac{1}{2} \div \frac{1}{2} = 13$ repeats: 13 round beads and 52 seed beads.

TRAIL 3 BADGE QUIZ

The badge quiz is optional. The student answers in writing, alone, then checks with a parent. Four right out of five earns the first badge; four right out of six earns the second. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. Who is traditionally named as the inventor of paper, in what country, and in what year?
2. In an origami diagram, what does a dashed line mean? A dash-and-dot line?
3. Which script, encouraged by Charlemagne around 800, gave us most of our lowercase letters?
4. What was the Penny Black, and why did cheap postage lead to greeting cards?
5. How do you make a teardrop shape in quilling?

Badge quiz 2 (Stops 6–8)

6. What four things belong on a herbarium specimen label?
7. Why do thin flowers such as pansies press better than thick ones such as marigolds?
8. How many pages does a quarto sheet make, and what is a signature?
9. Give one reason early Christians preferred the codex to the scroll.
10. Why did Venice move its glassmakers to Murano in 1291?
11. A wrist measures 6½ inches. About how long should the finished bracelet be?

TRAIL CERTIFICATE: MY PAPER AND HAND CRAFTS PORTFOLIO AND TRAIL C CERTIFICATE

Gather one finished piece from each stop: a handmade sheet of paper, a crane and its crease pattern, a lettered verse, a stationery set, a quilled sampler, a specimen sheet and bookmark, a sewn notebook, and a beaded bracelet. Put the flat pieces in a folder and the others in a labelled box.

Use your hand-sewn notebook from Stop C7 as the portfolio's record book. Write one page for each stop: the date, the materials, the diagram you drew, and one sentence about what you would do better next time.

Choose your best piece and give it as a gift with a handwritten card. When the portfolio is complete, a parent signs the Trail C certificate.

- **Craftsmanship:** Folds are crisp, edges are straight, glue is hidden, stitches are snug, and pieces are finished with no loose ends.
- **Planning and diagrams:** Each project has a labelled map, plan or diagram drawn before or alongside the work, with measurements where needed.
- **Knowledge:** The notebook entries tell the history of each craft accurately, with names, places and dates.
- **Diligence and care:** The student worked carefully and safely, cleaned up, and kept going when a piece had to be redone, doing the work “heartily, as to the Lord”

(Colossians 3:23).

Answer key

1. Cai Lun, in China, in AD 105.
2. A dashed line is a valley fold; a dash-and-dot line is a mountain fold.
3. Carolingian minuscule.
4. The first adhesive postage stamp (Britain, 1840). Once any letter cost only a penny, people could afford to send many cards, and Henry Cole sent the first commercial Christmas card in 1843.
5. Roll a loose coil, let it relax, glue the end, then pinch it at one point.
6. The plant's name, where it was found, when it was found, and who collected it.
7. They hold less water and lie flat, so they dry quickly in the press without browning or molding.
8. 8 pages (4 leaves). A signature is a group of folded sheets nested together and sewn as one unit.
9. Any one: it held more text, could carry several books in one volume, and let a reader turn straight to a passage.
10. To protect the city from fire and to keep the glassmakers' secrets.
11. About 7¼ inches (wrist plus about ¾ inch).

CRAFTS AND MAKING ≈ TRAIL D: MAKE IT, PRICE IT, SELL IT

The fourth trail of the Crafts and Making track turns handwork into a small, honest business. It begins with Bezaleel and Aholiab, the first craftsmen named in Scripture, who built the tabernacle with God-given skill, counted every talent of silver and let Moses inspect their work. Then the student chooses a product, counts the true cost of materials and time, sets a fair price, checks quality, designs a label and logo, runs a craft-fair table or family shop, and keeps the books to find the profit.

This is the ● **Ranger** level, for ages 10 to 13. The student reads each stop alone and works through it in 25 to 35 minutes. Every stop stands by itself, but the stops also build one real project: a small product line with a cost sheet, a price list, a quality checklist, a label, a table plan and a ledger, all kept in the Field Notebook. Each stop has a diagram or chart to draw, a paragraph to write and five practice problems with answers. Any real selling is done with a parent present and a parent's signature.

Five stops earn the **Maker and Merchant badge, part 1**; eight stops earn part 2 and the **Trail D certificate**.

BEFORE YOU BEGIN

- Add, subtract, multiply and divide money amounts, and find a simple percent (such as 10 or 25 percent) with a calculator if needed.
- Be able to make at least one simple craft (from Trails A–C or elsewhere) neatly and more than once.

MASTERY CHECKLIST

- ☐ I can tell who Bezaleel and Aholiab were and what their work teaches makers today.
- ☐ I can work out the true cost of one item, including materials, waste, labor and overhead.
- ☐ I can set a fair price above cost and near the market price, and explain why it is fair to both sides.
- ☐ I can write a quality standard, inspect a batch and find a defect rate.
- ☐ I can keep a ledger and use $\text{Revenue} - \text{Costs} = \text{Profit}$ to find my profit and break-even point.

OPTIONAL BOOKS AND RESOURCES

- **Junior Achievement (JA) student resources** (<https://jausa.ja.org>): Free lessons on money, business and entrepreneurship for children; useful for Stops D2–D4 and D8.
- **Rijksmuseum online collection** (<https://www.rijksmuseum.nl/en/collection>): Large, free, zoomable images of Rembrandt's *Sampling Officials* (Stop D5) and Brekelenkam's *Tailor's Workshop* (Stop D3).

- **Pitts Theology Library Digital Image Archive (Emory University)**
(<https://dia.pitts.emory.edu>): Free woodcuts from early printed Bibles, including Bezalel and Oholiab at work (Stop D1).
- **Museum of Fine Arts, Boston: Paul Revere collection** (<https://collections.mfa.org>):
Copley's portrait of Paul Revere and Revere's own marked silver (Stop D6).

4.1 BEZALEL AND AHOIAB, THE FIRST NAMED CRAFTSMEN

OBJECTIVES

- Read Exodus 31:1–6 and 35:30–35 and tell who Bezaleel and Aholiab were, their tribes and their crafts.
- Explain four things the tabernacle builders did that every good maker still does: use God-given skill, teach others, count materials honestly and let the work be inspected.
- Work with the Bible’s own numbers for the tabernacle: cubits, shekels and talents.

Warm-up. Think of the best-made thing in your house: a chair, a quilt, a tool, a pot. Who made it? Do you know the maker’s name? For most things we use, we never learn it. Today we meet the first craftsmen whose names God Himself spoke.

Video slot. Video coming. The tabernacle in the wilderness: how it was built, its furniture and its courtyard plan (Exodus 25–40). Search approved channels (a museum or full-size tabernacle model tour, Answers in Genesis, a church or seminary teaching channel); preview first.

KEY TERMS

tabernacle

The tent of worship God told Israel to build in the wilderness; it could be taken apart and carried from camp to camp.

craftsman

A person skilled at making things by hand, such as metalwork, carving, weaving or embroidery.

cubit

An old measure from the elbow to the tip of the middle finger, roughly 18 inches.

talent

A large weight used for gold and silver in the Bible; Exodus 38 shows that one talent equals 3,000 shekels.

freewill offering

A gift given gladly by choice, not by force or as a tax.

CORE IDEAS

At Mount Sinai, soon after leaving Egypt (about 1446 BC by one common reckoning; some scholars date it later), Israel received from God a detailed pattern for the **tabernacle**. Exodus 25–30 read almost like a builder’s plan. The courtyard was 100 cubits long and 50 wide (Exodus 27:18), about 150 by 75 feet. The ark of the covenant was 2½ cubits long, 1½ wide and 1½ high (Exodus 25:10), about 45 by 27 by 27 inches. Every board, ring, curtain and clasp had a size.

A plan, though, needs makers. In Exodus 31:2 the Lord says, “See, I have called by name Bezaleel the son of Uri, the son of Hur, of the tribe of Judah.” (Most modern books spell it *Bezalel*; the King James Version spells it *Bezaleel*.) God filled him “with the spirit of God, in wisdom, and in understanding, and in knowledge, and in all manner of workmanship”: gold, silver and brass, cutting and setting stones, and carving wood. Beside him God gave **Aholiab** the son of Ahisamach, of the tribe of Dan, “an engraver, and a cunning workman, and an embroiderer in blue, and in purple, and in scarlet, and in fine linen” (Exodus 38:23). In old English, *cunning* means skillful, not sneaky.

Notice three things. First, skill is a gift: Bezaleel is one of the first people in Scripture said to be filled with the Spirit of God, and the gift was for **craftsmanship**. Second, the gift was meant to be passed on: God “put in his heart that he may teach, both he, and Aholiab” (Exodus 35:34). Third, the two men came from different tribes. Judah camped on the east side of the tabernacle and Dan on the north (Numbers 2:3, 25), so the leaders of the work came from different ends of the camp.

The materials came as a **freewill offering**. Men and women brought gold earrings and bracelets, silver, brass, wood, and dyed yarn; “all the women that were wise hearted did spin with their hands” (Exodus 35:25). The people gave so much that the workmen told Moses they had more than enough, and Moses sent word through the camp to stop (Exodus 36:5–7). Few building projects in history have ended with too much money!

Then the work was counted. Exodus 38:21–31 is an account “of the tabernacle... as it was counted,” kept by Ithamar the priest. The gold came to 29 talents and 730 shekels. The silver came from a half shekel paid for each of 603,550 men, which is exactly 100 talents and 1,775 shekels. Finally the work was inspected: “Moses did look upon all the work, and, behold, they had done it as the LORD had commanded... and Moses blessed them” (Exodus 39:43). The tabernacle was set up on the first day of the first month of the second year (Exodus 40:17).

This trail follows the same path the tabernacle builders walked: choose good work, count the cost, deal honestly, check the quality, mark it with a good name, offer it to others and keep true accounts. Making and selling are not lesser work. Done well and honestly, they can be done “as to the Lord.”

PICTURE STUDY

Bezalel and Oholiab, Woodcut printed by Christoph Froschauer, Zurich, 1536 · Woodcut, from the German Bible *Die gantze Bibel* · Pitts Theology Library, Emory University, Atlanta (Digital Image Archive)

Christoph Froschauer was the great printer of Zurich in the Reformation years. His Bibles were filled with woodcuts so that readers, many of them new to reading the Scriptures in their own language, could picture the stories. This one shows Bezaleel and Aholiab at work on the tabernacle vessels, dressed and equipped like the metalworkers of a sixteenth-century Swiss town.

Look closely

- Find the furnace. What would a metalworker need fire for?
- Find the bowls and vessels. Which look finished and which are still being made?
- Look at the workshop and the clothes. Do they look like ancient Israel or like Europe in the 1500s?

Talk about it

1. Why do you think the artist drew Bible craftsmen like the craftsmen of his own town?
2. What does a woodcut have in common with the tabernacle work: planning, cutting, skill and many copies?

HANDS-ON: DRAW THE TABERNACLE COURTYARD TO SCALE

Bezaleel worked from exact measurements. You will too. Using the numbers in Exodus, draw a scale plan of the tabernacle courtyard, the way a craftsman lays out a job before cutting anything.

You will need

- Graph paper (or plain paper and a ruler)
- A pencil, an eraser and colored pencils
- A Bible (Exodus 26–27 and 38)

Steps

1. Choose a scale: 1 square = 5 cubits. The courtyard is 100 by 50 cubits, so draw a rectangle 20 squares long and 10 squares wide.
2. Mark east on the right side. The gate was on the east and was 20 cubits wide (Exodus 27:16), so it is 4 squares wide in the middle of the east side. Label it **Gate**.
3. Inside the gate, draw a small square for the **Brazen altar** (5 by 5 cubits, Exodus 27:1, so 1 square) and a small circle beyond it for the **Laver**.
4. In the western half, draw the tent, about 30 cubits long and 10 wide (6 squares by 2). Divide it: the larger eastern part is the **Holy place**; the western third is the **Most holy place**. Put a small box for the **Ark** there.
5. Add a scale bar and a north arrow. In a corner write: “Plan by Bezaleel and Aholiab; drawn by (your name).”

Check your work

- My courtyard is twice as long as it is wide, with a scale bar.
- The gate is on the east, with the altar, laver, holy place, most holy place and ark labeled.
- I used the numbers from the Bible, not a guess.

FIELD NOTEBOOK

1. **Notebook entry: The first named craftsmen.** Write a paragraph (5–7 sentences) about Bezaleel and Aholiab: their tribes, their crafts, and one thing they did that you want to copy in your own making.
2. Under the paragraph, list your own “gifts of the hand”: things you can already make or do well, and one you would like to learn.

Did you know? The silver for the tabernacle sockets came from a census tax: a half shekel for each man twenty years old and upward (Exodus 30:13–14; 38:25–27). That silver made 100 sockets, one talent each, to hold the boards upright. Rich and poor paid the same half shekel (Exodus 30:15).

Map or diagram. On a map of the Sinai Peninsula, find the traditional site of Mount Sinai (Jebel Musa) in the south. Scholars disagree about the exact mountain, so mark it with a question mark.

Goes deeper in. History, “Ancient Israel and the Exodus,” and Small Business & Economics, “Work and Vocation” (coming soon).

For families. Sources: Exodus 25–40; Numbers 2 (KJV). The 1446 BC date follows 1 Kings 6:1; many scholars prefer a thirteenth-century date, so the stop gives it as one reckoning. The cubit is taken as about 18 inches; some use 20.6 inches (the “royal” cubit), so all conversions are approximate. The tent’s 30-by-10-cubit size is worked out from the boards in Exodus 26 and is the common reconstruction. Picture: woodcut in *Die gantze Bibel* (Zurich: Christoph Froschauer, 1536), Pitts Theology Library Digital Image Archive; the woodcut’s designer is not named in the record.

PRACTICE

1. **EASY** Name Bezaleel’s tribe and Aholiab’s tribe.
2. **EASY** What does “cunning workman” mean in the King James Version?
3. **MEDIUM** Each of 603,550 men gave a half shekel of silver. How many shekels is that?
4. **CHALLENGE** One talent is 3,000 shekels. Write 301,775 shekels as talents and shekels, and compare your answer with Exodus 38:25.
5. **CHALLENGE** If a cubit is 18 inches, how big was the ark ($2\frac{1}{2}$ by $1\frac{1}{2}$ by $1\frac{1}{2}$ cubits) in inches? In feet?

Make it a game • Bring Enough, Then Stop. One player is Moses with a list of 10 “materials” needed (for example, 3 gold buttons, 4 blue threads, 3 sticks). The others race to bring items from around the room and lay them down. Moses counts aloud. The moment every item on the list is met, Moses calls “Enough!” Anyone who brings one more after that must put it back. Talk about it: how did the people in Exodus 36 know when to stop?

Scripture. “And I have filled him with the spirit of God, in wisdom, and in understanding, and in knowledge, and in all manner of workmanship,” (Exodus 31:3, KJV)

God spoke these words about Bezaleel. Skill with the hands is not a small or second-rate gift. It is wisdom from God, given for real work, and meant to be taught to others.

Practice: answers

1. Bezaleel was of the tribe of Judah; Aholiab was of the tribe of Dan.
2. A skillful workman; “cunning” in old English means skilled, not sneaky.
3. $603,550 \div 2 = 301,775$ shekels.
4. $301,775 \div 3,000 = 100$ talents with 1,775 shekels left over. Exodus 38:25 says exactly “an hundred talents, and a thousand seven hundred and threescore and fifteen shekels.”
5. 45 by 27 by 27 inches, which is 3 feet 9 inches by 2 feet 3 inches by 2 feet 3 inches.

4.2 CHOOSE A PRODUCT

OBJECTIVES

- Use five tests to choose a product: skill, repeatability, cost, time and demand.
- Do simple market research by asking real people and counting the answers.
- Plan a small product line of two or three related items.

Warm-up. Make a quick list of everything you have made with your hands in the last year: cards, bookmarks, bracelets, cookies, birdhouses, anything. Circle the one that people asked about or praised the most.

Video slot. Video coming. How a small maker chooses a product to sell; kids' business basics, market research and product lines. Search approved channels (Junior Achievement, a 4-H channel, Khan Academy "entrepreneurship" videos); preview first.

KEY TERMS

product

A thing made to be sold or given, made the same way each time.

demand

How many people want a product and are willing to pay for it.

market research

Finding out what customers want before you make a lot of something, by asking, watching and counting.

product line

A small family of related products, such as bookmarks, cards and gift tags made from the same pressed flowers.

prototype

A first test version of a product, made to learn from before making many.

CORE IDEAS

For most of history, a craftsman did not make "a bit of everything." He or she made one kind of thing very well. In 1568 a book printed in Frankfurt, the *Ständebuch* or "Book of Trades," showed more than a hundred woodcuts by Jost Amman, each with a little poem by Hans Sachs: the papermaker, the printer, the shoemaker, the hatter, the potter, the bookbinder, the comb-maker. Each trade was known by its **product**. Townspeople knew where to go for a comb or a pair of shoes because each maker had chosen a thing and become known for it.

Proverbs 31 describes a wise woman who did the same. "She maketh fine linen, and selleth it; and delivereth girdles unto the merchant" (verse 24). A girdle was a belt or sash. She had

a product, she sold it herself and to merchants, and verse 18 says “she perceiveth that her merchandise is good.” She knew her goods were worth buying.

How do you choose? Ask five questions. **Skill:** can I make it well, not just once but every time? **Repeatability:** can I make ten that look alike? A one-of-a-kind painting is lovely, but a bookmark you can make in a batch is easier to sell. **Cost:** are the materials cheap enough? **Time:** how long does one take? A scarf that takes 12 hours is a gift, not a good first product. **Demand:** does anyone actually want it?

The last question is the one beginners skip. Many makers fill a box with things that nobody wants. So do **market research**. Make a **prototype** of your two or three best ideas. Show them to at least ten people outside your family if you can: neighbors, church friends, a grandparent’s friends. Ask, “Which would you most like to buy, and what would you pay?” Write down every answer. If 7 out of 10 pick the bookmark, that is 70 percent, and that tells you more than your own guess.

Next, think in a **product line**. Shops have long grouped goods that share materials and buyers. If you press flowers, you might sell bookmarks, cards and gift tags, all from the same flowers, glue and cardstock. One set of supplies, three products, and a customer who likes one may buy another. Keep the line small: two or three items done well beat ten items done carelessly.

Finally, ask whether the product is good. Is it honest, useful or beautiful? Will it last? Does it bring glory to God and do good to the buyer? A product is a promise. When you choose one, you are promising to make it well every time.

PICTURE STUDY



Woodcuts from the Ständebuch (Book of Trades), Jost Amman, with verses by Hans Sachs, 1568 · Woodcuts in a printed book · Many library copies; digitized by several libraries and on Wikimedia Commons
Wikimedia Commons · Public domain

Jost Amman was a Swiss-born artist who worked in Nuremberg. For this book he cut a picture of each trade, and the shoemaker-poet Hans Sachs wrote a short rhyme for each, spoken by the worker. Look at three or four pages: for example, the papermaker, the printer, the bookbinder and the shoemaker.

Look closely

- In each woodcut, find the finished product. Where is it shown?
- Find the tools. Which trade needs the most tools?
- Find a customer or a helper. Who else is in the shop?

Talk about it

1. If you had a page in a Book of Trades today, what would your one product be?
2. Why might a town be better off with many makers who each do one thing well?

Safety first. If any product idea uses a hot glue gun, craft knife, oven, needles or wire, test it only with a parent nearby, and keep sharp tools and hot tools away from younger children.

HANDS-ON: PRODUCT CHOICE CHART AND MARKET SURVEY

Score your ideas, build prototypes of the top two, and let real people help you choose.

You will need

- Notebook or graph paper and a ruler
- Materials for two simple prototypes
- A pencil and a clipboard for the survey

Steps

1. Write three to five product ideas down the left side of a page. Across the top, write five columns: Skill, Repeat, Cost, Time, Demand.
2. Score each idea from 1 (poor) to 3 (good) in every column. Add the scores across.
3. Make one prototype of each of your top two ideas. Time yourself and write the minutes down.
4. Show both prototypes to at least ten people. Ask: “Which would you rather buy?” and “What would you pay for it?” Make a tally chart of the answers.
5. Draw a bar graph of the votes, labeled with the product names, a title and the number of people asked. Circle your chosen product and name two other items that could join it in a product line.
6. Before you sell anything for real, show your plan to a parent and get their sign-off:
Parent signature _____ Date _____.

Check your work

- I scored my ideas with all five tests.
- I asked at least ten people and drew a labeled bar graph of the answers.
- I chose one product and planned a small product line.

FIELD NOTEBOOK

1. **Notebook entry: My product.** Write a paragraph telling which product you chose and why. Use at least two numbers from your survey (for example, “6 of 10 people chose the bookmark”).
2. Paste or draw your bar graph beneath it.

Did you know? Many family names come from products and trades: Smith, Baker, Potter, Weaver, Taylor (tailor), Turner (a maker of things on a lathe), Cooper (a barrel-maker), Fletcher (an arrow-maker) and Chandler (a candle-maker). A whole family could be known for what an ancestor made.

Goes deeper in. Small Business & Economics, “Supply and Demand” and “Starting a Small Business” (coming soon).

For families. Sources: Proverbs 31:18, 24 (KJV); Jost Amman and Hans Sachs, *Eygentliche Beschreibung aller Stände auff Erden* (Frankfurt: Sigmund Feyerabend, 1568). The book has just over a hundred woodcuts; counts differ slightly by edition, so the

stop says “more than a hundred.” Please supervise the survey: children should ask people they or you know, not strangers.

PRACTICE

1. **EASY** Name the five tests for choosing a product.
2. **EASY** What is a prototype?
3. **MEDIUM** In a survey of 20 people, 13 chose bookmarks and 7 chose cards. What percent chose bookmarks?
4. **MEDIUM** Give an example of a product line of three items that share the same materials.
5. **CHALLENGE** A beaded bracelet takes 40 minutes; a woven bookmark takes 15 minutes. How many of each could you make in 4 hours of work? Which is the better first product if both sell equally well, and why?

Make it a game • Name That Trade. One player names a product (“horseshoe,” “barrel,” “candle,” “arrow,” “book”). The others race to name the trade and the family name that comes from it (smith, cooper, chandler, fletcher, bookbinder). A correct answer earns the right to call the next product.

Scripture. “She maketh fine linen, and selleth it; and delivereth girdles unto the merchant.” (Proverbs 31:24, KJV)

The wise woman of Proverbs 31 had a product she made well, sold it to buyers and supplied it to merchants. Scripture praises good, honest making and selling as part of a wise and godly life.

Practice: answers

1. Skill, repeatability, cost, time and demand.
2. A first test version of a product, made to learn from before making many.
3. $13 \div 20 = 0.65$, so 65 percent.
4. Sample answer: bookmarks, greeting cards and gift tags all made from pressed flowers and cardstock. Any three related items that share supplies and buyers are correct.
5. 4 hours = 240 minutes. Bracelets: $240 \div 40 = 6$. Bookmarks: $240 \div 15 = 16$. The bookmark is the better first product, because you can make more than twice as many in the same time.

4.3 COSTING MATERIALS AND TIME

OBJECTIVES

- Work out the material cost of one item from the price of a whole package.
- Put a value on your time with an hourly rate and add it to the cost.
- Include small costs (overhead and waste) so the total cost is honest.

Warm-up. A pack of 50 sheets of cardstock costs \$5.00. You use one sheet for a card. How much did the cardstock in your card cost? (Hint: it is not \$5.00.)

Video slot. Video coming. How to calculate the cost of a handmade item: materials per unit, labor, overhead. Search approved channels (Junior Achievement, Khan Academy, a 4-H or Etsy-free maker-business channel); preview first.

KEY TERMS

unit cost

What one item costs to make: the total cost divided by the number of items.

materials cost

The cost of everything that goes into the item, such as paper, yarn, beads or glue.

labor

The work of making, measured in time; its cost is the hours worked times an hourly rate.

overhead

Costs that are not part of any one item but are needed to run the business, such as tools, packaging, table fees or printer ink.

waste

Materials spoiled, trimmed off or used for mistakes; a careful maker adds a little extra to cover it.

CORE IDEAS

Jesus once asked, “For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he have sufficient to finish it?” (Luke 14:28). He was teaching about following Him with your whole life, and He used an example everyone understood: a wise builder adds up the cost before he starts. Makers have always had to do the same.

Start with **materials cost**. You almost never buy materials one item at a time. You buy a skein of yarn, a pack of beads, a roll of ribbon. So divide. If a 50-sheet pack of cardstock costs \$5.00, each sheet costs $\$5.00 \div 50 = \0.10 . If a 10-yard roll of ribbon costs \$3.00 and each bookmark uses 9 inches, a yard (36 inches) makes 4 bookmarks; 10 yards makes 40, so the ribbon for one bookmark costs $\$3.00 \div 40 = 7\frac{1}{2}$ cents. Add up every material and you have the **unit cost** of materials.

Next add **waste**. A careful maker still trims edges, ruins a piece now and then, and spills some glue. Many makers add about 10 percent to the materials cost to cover this. If materials come to \$0.60, add \$0.06 for \$0.66.

Then count **labor**. Your time is worth something. In the Dutch tailors' shop in this stop's picture, every coat was priced to pay for the cloth and also for the days the tailors sat cross-legged on their bench sewing it. Pick an hourly rate with a parent, for example \$6.00 an hour. If a bookmark takes 10 minutes, that is $\frac{1}{6}$ of an hour, so labor is $\$6.00 \div 6 = \1.00 . Time yourself on several items, not just one; the tenth is usually faster than the first.

Last, count **overhead**. Scissors, a hole punch, a laminator, bags and a table fee at a fair are not part of any one bookmark, but they cost money. Add them up and share them among the items you expect to make. If overhead is \$12.00 and you plan to make 60 bookmarks, each carries $\$12.00 \div 60 = \0.20 .

Now add it all: materials with waste (\$0.66) + labor (\$1.00) + overhead (\$0.20) = **\$1.86** true cost for one bookmark. Many beginners think a bookmark "costs" 60 cents because that is what the paper and ribbon cost. But if you sold it for \$1.00, you would be paying for the tools yourself and working for almost nothing. Counting the cost honestly is the first step to a fair price, which is the next stop.

PICTURE STUDY



The Tailor's Workshop, Quiringh van Brekelenkam, 1661 · Oil on panel · Rijksmuseum, Amsterdam (on loan from the City of Amsterdam)

Wikimedia Commons · Public domain

Quiringh van Brekelenkam lived in Leiden and painted tailors' workshops several times. Tailors sat on a raised platform by the window to get the most daylight, because candles cost

money and stitching needs good light. A woman on her way to market has stopped to look at a coat. Will she buy it?

Look closely

- Find the window. Why are the tailors sitting so close to it?
- Find the hank of thread hanging ready. What other materials can you see?
- Find the customer. What is she looking at?

Talk about it

1. List every cost the tailor must cover before the coat makes him any money (think of cloth, thread, rent, light, time).
2. Why does a coat cost more than the cloth it is made from?

HANDS-ON: COST SHEET FOR YOUR PRODUCT

Make a cost sheet for the product you chose in Stop D2. A cost sheet is a table every real business uses.

You will need

- Receipts or price tags for your materials (or prices looked up with a parent)
- A timer or clock
- A ruler, pencil and calculator

Steps

1. Draw a table with four columns: **Material, Package price, How many items it makes, Cost per item**. Fill in one row for each material and divide to find the cost per item.
2. Add the cost-per-item column for your materials total. Add 10 percent for waste.
3. Make three items and time each one. Find the average time. With a parent, choose an hourly rate and work out the labor cost per item.
4. List your overhead (tools, bags, labels, fees). Divide the total by the number of items you plan to make.
5. Draw a **cost bar**: one long bar divided into three colored parts labeled Materials, Labor and Overhead, with the dollar amount written on each part and the total at the end.

Check your work

- Every material is divided down to a cost per item.
- I included waste, labor and overhead, not only materials.
- My cost bar is labeled and its total matches my table.

FIELD NOTEBOOK

1. **Notebook entry: What my product really costs.** Write a paragraph explaining the true cost of one item, with numbers. Which part surprised you the most: materials, labor or overhead? Why?
2. Copy your cost bar into the notebook.

Did you know? Before electric light, many workshops stopped at dusk or used costly candles and oil lamps. That is one reason old workshops crowded their benches against the windows, and why winter work, with its short days, cost makers more.

Goes deeper in. Arithmetic, “Dividing Money and Unit Rates,” and Small Business & Economics, “Costs, Revenue and Profit” (coming soon).

For families. Sources: Luke 14:28 (KJV); Rijksmuseum record for Brekelenkam, *The Tailor’s Workshop*, SK-C-112. The \$6.00 hourly rate and 10 percent waste allowance are teaching numbers, not rules; choose a rate with your child. Some families prefer not to count a child’s labor at all for a first project; the stop counts it so the child sees what time is worth.

PRACTICE

1. **EASY** A pack of 100 beads costs \$4.00. What does one bead cost?
2. **EASY** Name the three main kinds of cost in this stop.
3. **MEDIUM** A bracelet uses 20 beads at 4 cents each and 10 cents of cord. What is the materials cost, and what is it after adding 10 percent for waste?
4. **MEDIUM** At \$6.00 an hour, what is the labor cost of an item that takes 20 minutes?
5. **CHALLENGE** Materials with waste are \$0.99, labor is \$2.00, and overhead is \$15.00 shared over 50 bracelets. What is the true cost of one bracelet?

Make it a game • Divide the Package. Write package prices on cards (“\$6.00 for 30 sheets,” “\$2.00 for 8 tags,” “\$9.00 for 100 beads”). Flip a card; the first player to say the cost of one item correctly keeps the card. Most cards after ten rounds wins. Older players can add “and what do 12 cost?”

Scripture. “For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he have sufficient to finish it?” (Luke 14:28, KJV)

Jesus spoke of counting the cost of following Him, and He drew His example from ordinary building. A wise maker sits down first and counts every cost honestly before starting.

Practice: answers

1. $\$4.00 \div 100 = \0.04 , or 4 cents.
2. Materials, labor and overhead (with a little extra added for waste).

3. $20 \times \$0.04 = \0.80 , plus $\$0.10 = \0.90 . Adding 10 percent ($\$0.09$) gives $\$0.99$.
4. 20 minutes is $\frac{1}{3}$ of an hour, so $\$6.00 \div 3 = \2.00 .
5. Overhead per bracelet is $\$15.00 \div 50 = \0.30 . Total: $\$0.99 + \$2.00 + \$0.30 = \3.29 .

4.4 SETTING A FAIR PRICE

OBJECTIVES

- Set a price by adding a profit markup to the true cost.
- Check the price against what similar items sell for (the market price).
- Explain what makes a price fair to both the maker and the buyer, and why Scripture cares about honest weights and measures.

Warm-up. Your true cost for one item is \$2.00. Would you sell it for \$1.50? For \$2.00? For \$20.00? Say what is wrong with each, and guess a price that seems right.

Video slot. Video coming. How to price handmade items: cost-plus pricing, markup, comparing prices. Search approved channels (Junior Achievement, Khan Academy “markup and percent” lessons, a 4-H entrepreneurship channel); preview first.

KEY TERMS

price

The amount of money a seller asks for a product.

profit

The money left over after all costs are paid.

markup

The amount, often written as a percent of cost, added to the cost to set the price.

market price

What buyers usually pay for similar items in the same place at the same time.

just weight

An honest measure that gives the buyer exactly what he pays for; Scripture condemns false scales and weights.

CORE IDEAS

In the Old Testament, buying and selling usually meant weighing: grain, spices, silver. A cheating seller could keep two sets of weights, a heavy one for buying and a light one for selling. God forbade it. “Ye shall do no unrighteousness in judgment, in meteyard, in weight, or in measure. Just balances, just weights... shall ye have” (Leviticus 19:35–36). “A false balance is abomination to the LORD: but a just weight is his delight” (Proverbs 11:1). A fair price begins with honesty: the buyer gets what he is told he is getting.

Christians kept thinking about this for centuries. In the 1200s Thomas Aquinas taught that it is sinful to deceive a buyer in order to sell a thing for more than its **just price**. In England, the Assize of Bread and Ale (about 1266) tied the price and weight of a loaf to the price of

grain, and bakers who sold short loaves could be fined. Towns appointed officers to test scales and measures in the market.

How do you find a fair price today? Step one is your true cost from the last stop. Selling below cost means losing money on every sale. Step two is a **markup** for **profit**. Profit is not greed; it pays for growing the business, replacing tools, saving and giving. If a bookmark truly costs \$1.86 and you add a 25 percent markup, that is $\$1.86 \times 0.25 \approx \0.47 , for a price of about \$2.33.

Step three is the **market price**. Look at what similar items cost at a craft fair, a church bazaar or a shop. If handmade bookmarks there sell for \$2.00 to \$3.00, then \$2.33 fits. Round to a price that is easy to pay and easy to make change for, such as \$2.50. If your price is far above the market, ask whether your item is truly better, or whether your costs are too high. If it is far below, you may be underselling your work.

Some makers offer a **bundle**: one bookmark for \$2.50, or three for \$6.00. The buyer saves \$1.50, and the maker sells more in one sale. That is fair to both, as long as the three-for price is still above three times the cost (\$5.58).

A fair price is fair to both sides. The buyer pays what the item is honestly worth and knows exactly what he gets. The maker is paid for materials, time and skill. Prices should be the same for everyone, written plainly on a sign, with no tricks. That is the market-stall version of a just weight.

PICTURE STUDY



The Moneylender and His Wife, Quentin Matsys (also spelled Massys), 1514 · Oil on panel · Musée du Louvre, Paris
Wikimedia Commons · Public domain

Quentin Matsys worked in Antwerp, then one of the busiest trading cities in Europe. A man carefully weighs coins and pearls on a little balance. Coins were weighed because people shaved or clipped bits of silver and gold off them. His wife is turning the pages of a prayer book, yet her eyes have drifted to the money. An old description says the original frame bore words from Leviticus 19:36 about just balances.

Look closely

- Find the balance. What is being weighed?
- Find the prayer book. Where is the wife looking?
- Find the small round mirror on the table. What, or who, do you see in it?

Talk about it

1. Why would the painter put a prayer book and a pair of scales side by side?
2. How does this painting remind a maker to keep God first while handling money?

HANDS-ON: PRICE TAG, PRICE LIST AND PRICE LADDER

Set a fair price for your product and make a price list you could put on a table.

You will need

- Your cost sheet from Stop D3
- Prices of three similar items (from a fair, shop, catalog or website, looked up with a parent)
- Cardstock, ruler, pencils and a fine marker

Steps

1. Write your true cost for one item at the top of a page.
2. Work out three prices: cost + 10 percent, cost + 25 percent and cost + 50 percent.
3. Write down the three market prices you found. Draw a **price ladder**: a vertical line labeled from \$0 at the bottom up to a little more than your highest price. Mark and label your cost, your three markup prices and the three market prices on it.
4. Choose your price. It must be above cost and near the market. Round it to an easy amount.
5. Make a neat price list on cardstock with each product, its price and any bundle offer.
6. Before you sell for real, a parent checks your prices and signs: Parent signature _____ Date _____.

Check your work

- My price is above my true cost.
- My price ladder is labeled and shows cost, markups and market prices.
- My price list is neat, plain and the same for every buyer.

FIELD NOTEBOOK

1. **Notebook entry: A fair price.** Write a paragraph explaining the price you chose. Use your cost, your markup and the market prices. Finish with one sentence on why your price is fair to both you and your buyer.
2. Copy your price ladder into the notebook.

Did you know? A popular story says the “baker’s dozen” of 13 began because medieval bakers added an extra loaf to be sure they never sold short and were fined. Historians are not certain this is the true origin, but it shows how seriously honest measure was taken.

Goes deeper in. Arithmetic, “Percents,” and Small Business & Economics, “Prices and Markets” (coming soon).

For families. Sources: Leviticus 19:35–36; Proverbs 11:1 (KJV); Thomas Aquinas, *Summa Theologiae* II-II, q. 77, a. 1; the Assize of Bread and Ale (usually dated to the reign of Henry III, about 1266). The Matsys frame inscription is known from a seventeenth-century description; the present frame is not original. Markup percentages here are teaching figures. A 25 percent markup on \$1.86 is \$0.465, rounded to \$0.47.

PRACTICE

1. **EASY** What is profit?
2. **EASY** What does Proverbs 11:1 say about a false balance?
3. **MEDIUM** An item costs \$3.00 to make. What is the price with a 50 percent markup?
4. **MEDIUM** A card costs \$1.20. You sell it for \$2.00. How much profit do you make on each card, and on 15 cards?
5. **CHALLENGE** Bookmarks cost \$1.86 each. You sell one for \$2.50 or three for \$6.00. How much profit is made on a three-pack? Is the bundle still fair to the maker?

Make it a game • Honest Scales. Make a balance from a coat hanger and two cups on strings. One player secretly fills a bag with beans to be “one pound” (or uses a kitchen scale to make it exact) and another bag that is short. The buyer must test each bag against a true weight (a 1-pound can or bag of sugar). Find the short bag and say Proverbs 11:1 together.

Scripture. “A false balance is abomination to the LORD: but a just weight is his delight.” (Proverbs 11:1, KJV)

God cares about honest trade in the smallest details. A fair price, plainly marked and the same for everyone, is a just weight for today’s maker.

Practice: answers

1. The money left over after all costs are paid.

2. "A false balance is abomination to the LORD: but a just weight is his delight."
3. $\$3.00 \times 0.50 = \1.50 markup; price \$4.50.
4. $\$2.00 - \$1.20 = \$0.80$ each. $15 \times \$0.80 = \12.00 .
5. Cost of three: $3 \times \$1.86 = \5.58 . Profit: $\$6.00 - \$5.58 = \$0.42$. Yes, it is still above cost, though the profit per bookmark (\$0.14) is much smaller than on a single sale (\$0.64).

4.5 QUALITY CONTROL: WOULD YOU BUY IT?

OBJECTIVES

- Write a quality standard for your product with measurable checks.
- Inspect a batch of items, sort them into pass, fix and seconds, and work out a defect rate.
- Explain how guild inspectors guarded quality in the past and why a Christian maker works “heartily, as to the Lord.”

Warm-up. Pick up something you bought that broke too soon or came out wrong. What went wrong? Now pick up something that has lasted for years. What makes the difference?

Video slot. Video coming. How factories and craftsmen inspect products; quality control for kids; Rembrandt’s Syndics of the Drapers’ Guild explained. Search approved channels (Rijksmuseum, Smarthistory, How It’s Made clips); preview first.

KEY TERMS

quality control

Checking products against a standard so that only good ones reach the buyer.

standard

A clear description of what a good product must be: its size, look, strength and finish.

defect

A flaw that makes a product fail its standard, such as a crooked edge, a loose bead or a smudge.

guild

An association of craftsmen in a trade that trained apprentices and set and enforced standards of work.

seconds

Items with small flaws that still work; sold at a lower price and marked plainly, or given away.

CORE IDEAS

In 1662 Rembrandt finished a group portrait for the cloth-makers’ guild of Amsterdam. Its Dutch name is *De Staalmeesters*, the “sample masters.” Each year the city chose officials to judge the quality of dyed cloth. They compared each bolt with samples (Dutch *staal*) of the approved color and quality, and cloth that passed received small lead seals. Amsterdam’s cloth trade depended on buyers being able to trust those seals.

Such men belonged to the world of **guilds**. From the Middle Ages, most European towns had guilds for weavers, smiths, bakers, goldsmiths and others. A boy usually began as an **apprentice** for several years, became a journeyman who worked for wages, and might become a master by making a “masterpiece,” a piece good enough to prove his skill to the guild. That is where our word *masterpiece* comes from. Guilds had faults: they sometimes kept out rivals and kept prices high. But they knew that one bad product could hurt every maker in the town.

You can be your own sample master. Begin with a written **standard**. Make it measurable, not just “nice.” For a bookmark: “6 inches by 2 inches, within $\frac{1}{8}$ inch; corners square; no glue showing; ribbon tied tight and trimmed even; no smudges.” Make your best sample and keep it as the model, just as the *staalmeesters* kept their samples.

Next, inspect. Check every item in your first batch. Sort each into three piles: **pass**, **fix** (can be repaired) and **seconds** (works but has a flaw that cannot be fixed). Count them. If you made 20 and 3 had **defects**, your defect rate is $3 \div 20 = 15$ percent. Look for patterns: if all 3 had glue showing, you need less glue or a better tool, not more checking. Fix the cause, not just the item.

The best single test is the one in this stop’s title: *Would you buy it?* Would you pay your own price for this item, with your own money, and be glad? If not, it is not ready. Seconds may be sold at a lower price only if plainly marked as seconds, or used as gifts and samples. Hiding a flaw from a buyer is a false balance.

For a Christian, quality is not only good business. Paul wrote to slaves and masters alike, “whatsoever ye do, do it heartily, as to the Lord, and not unto men” (Colossians 3:23). The Lord sees the hidden stitches, the back of the drawer and the underside of the bookmark. A maker who works for Him works well even where no customer will look.

PICTURE STUDY



The Sampling Officials of the Amsterdam Drapers' Guild (De Staalmeesters), Rembrandt van Rijn, 1662 · Oil on canvas · Rijksmuseum, Amsterdam
Wikimedia Commons · Public domain

Rembrandt painted this for the meeting room of the cloth inspectors. Five officials in black sit or stand at a table spread with a thick Oriental carpet. An open book lies before them. A servant without a hat stands behind. They look up as if someone has just walked in to hear their judgment.

Look closely

- Count the men with hats. Who is the one without a hat?
- Find the open book. What might the inspectors have written in it?
- Look at the carpet. How did Rembrandt show that it is thick and soft?

Talk about it

1. Why would a whole city's trade depend on these few men doing their job honestly?
2. If you were a cloth-maker bringing your work before these men, how would you feel? Why?

Safety first. If you trim with a craft knife or use a hot glue gun to fix items, have a parent nearby, cut on a mat away from your fingers, and unplug the glue gun when you finish.

HANDS-ON: BE YOUR OWN SAMPLE MASTER

Write a standard, make a batch, inspect it and improve your process.

You will need

- Materials to make 8–12 of your product
- A ruler and a magnifying glass (optional)
- Three labeled boxes or paper sheets: Pass, Fix, Seconds

Steps

1. Write your standard as a checklist of four to six measurable points. Make one perfect sample and label it **Model**.
2. Make a batch of 8 to 12 items as you normally would.
3. Inspect each item against every point on the checklist and the Model. Sort it into Pass, Fix or Seconds.
4. Draw an **inspection diagram**: a large outline drawing of your product with arrows and labels pointing to each place you check (for example, “corner square,” “no glue here,” “ribbon tight”). Mark with a red X the spot where most defects happened.
5. Count the piles and find your defect rate. Write one change you will make to your process, then make three more and see if they pass.

Check your work

- My standard has measurable points, and I kept a Model.
- I sorted every item and worked out my defect rate.
- My inspection diagram is labeled, and I changed my process to fix the most common defect.

FIELD NOTEBOOK

1. **Notebook entry: Would I buy it?** Write a paragraph about your inspection: how many items passed, your defect rate, the most common defect and how you fixed its cause. End by answering honestly: would you buy your own product at your price?
2. Glue your inspection diagram or a copy of your checklist beneath it.

Did you know? For Rembrandt’s painting, X-rays show that the servant was moved several times before Rembrandt settled on his place. Rembrandt also adjusted other figures while working. Even a great master inspected and reworked his own work until it was right.

Goes deeper in. Art, “Rembrandt and the Dutch Golden Age,” and History, “Towns, Guilds and Trade in the Middle Ages” (coming soon).

For families. Sources: Rijksmuseum, *The Sampling Officials* (SK-C-6); Colossians 3:22–23 (KJV). The staalmeesters’ work of testing dyed cloth against samples and sealing approved cloth is well documented; details varied over time. Colossians 3:23 was first addressed to servants (bondservants) and applies to all Christians’ work; the stop states this plainly. Some printings of the painting’s title use “Syndics of the Drapers’ Guild.”

PRACTICE

1. **EASY** What does *staalmeesters* mean, and what did they do?
2. **EASY** Name the three piles for sorting items in an inspection.
3. **MEDIUM** You made 25 cards and 2 had defects. What is your defect rate?
4. **MEDIUM** Rewrite this standard so it can be measured: “The bookmark should look nice.”
5. **CHALLENGE** Your first batch of 20 had 5 defects, all from glue showing. You changed to a glue stick, and your next batch of 20 had 1 defect. By how many percentage points did the defect rate drop?

Make it a game · Spot the Defect. One player makes five “identical” paper items (folded cards or cut squares) and secretly adds a small flaw to two of them. The inspector has one minute with a ruler to find the flawed items and name each defect. Switch roles. Who is the sharpest sample master?

Scripture. “And whatsoever ye do, do it heartily, as to the Lord, and not unto men;” (Colossians 3:23, KJV)

The final inspector of every maker’s work is the Lord. Working heartily for Him means doing the hidden parts as well as the parts a customer will see.

Practice: answers

1. “Sample masters.” They checked the quality of dyed cloth in Amsterdam against approved samples.
2. Pass, fix and seconds.
3. $2 \div 25 = 0.08$, or 8 percent.
4. Sample answer: “The bookmark is 6 by 2 inches within $\frac{1}{8}$ inch, with square corners, no glue showing, and the ribbon tied tight and trimmed even.” Any answer with sizes or yes/no checks is correct.
5. First: $5 \div 20 = 25$ percent. Second: $1 \div 20 = 5$ percent. It dropped by 20 percentage points.

4.6 LABELS, PACKAGING AND A SIMPLE LOGO

OBJECTIVES

- Tell how goldsmiths' hallmarks and makers' marks became the ancestors of today's logos.
- Design a simple logo that is clear when small and in one color.
- Make an honest label and simple packaging that protect the product and tell the buyer what it is.

Warm-up. Look at five packages in your kitchen. Without reading the words, can you tell which company made each one? What helped you know: a color, a shape, a picture?

Video slot. Video coming. What is a hallmark on silver; how Paul Revere marked his silver; how to design a simple logo for kids. Search approved channels (Museum of Fine Arts Boston, the Goldsmiths' Company, Smithsonian, Khan Academy design basics); preview first.

KEY TERMS

maker's mark

A small stamp or sign that shows who made an item, such as a silversmith's initials.

hallmark

An official mark stamped on gold or silver to show its purity; named for Goldsmiths' Hall in London.

logo

A simple picture, letters or shape that stands for a maker or a business.

label

A tag or sticker that tells the buyer the product's name, maker, materials, care and price.

packaging

The bag, box or wrap that protects a product and presents it to the buyer.

CORE IDEAS

Marks on goods are very old. Potters in the ancient world pressed stamps into jar handles, and Roman brickmakers stamped their bricks. But the best-known story of makers' marks comes from silver and gold. Because a buyer could not tell by looking how much cheaper metal had been mixed in, England passed a law in 1300, under King Edward I, that silver must meet a set standard and be tested and stamped with a leopard's head. From 1363 every goldsmith had to add his own **maker's mark** as well. The testing came to be done at Goldsmiths' Hall in London, which is why we still call any mark of quality a **hallmark**.

In colonial Boston, Paul Revere was a silversmith long before his famous ride of April 18, 1775. He stamped his work with his surname, REVERE, in a small rectangle, and sometimes with his initials. Collectors today look for that mark. It told buyers then, and tells museums now, exactly who stood behind the teapot or spoon. A mark is a promise with your name on it.

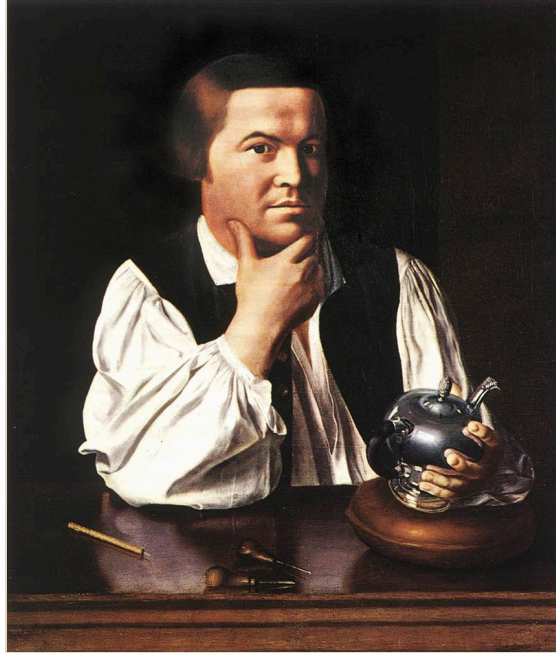
A modern **logo** does the same job. The best logos are simple. Test yours three ways: Can it be drawn in one color? Can it be read when it is as small as a postage stamp? Can someone tell what it is after a two-second glance? Many strong logos are just initials in a shape, a single object (a leaf, a needle, a star), or a name in clear letters. Avoid tiny details and too many colors; they vanish when printed small.

Next comes the **label**. An honest label answers the buyer's questions: What is it? Who made it? What is it made of? How do I care for it? How much is it? In the United States a federal rule from the 1970s requires most clothing sold to carry a care label, so buyers know how to wash it. Your bookmark does not need one by law, but a short line such as "Pressed flowers under clear film. Keep dry." helps the buyer and shows care. Never claim what is not true: do not write "real silver" on plated wire or "handmade" on something you bought.

Last is **packaging**. It must protect the product, keep it clean and make it easy to carry. In 1898 the National Biscuit Company sold Uneeda Biscuits in a waxed-paper-lined carton it called the "In-er-seal." Before that, crackers were scooped from open barrels in the general store. The new package kept them fresh and carried the company's name into every kitchen. For a small maker, a clear bag with a folded card on top, a paper sleeve, or a ribbon and tag can do the same.

Proverbs says, "A good name is rather to be chosen than great riches" (22:1). Your logo and label put your name on your work. Make sure the work deserves it.

PICTURE STUDY



Paul Revere, John Singleton Copley, 1768 · Oil on canvas · Museum of Fine Arts, Boston
Wikimedia Commons · Public domain

John Singleton Copley was the finest portrait painter in colonial America. Most of his sitters wore their best coats. Copley painted Paul Revere in his shirtsleeves at work, holding a silver teapot that is not yet engraved, with his engraving tools on the table beside him. It is a portrait of a craftsman proud of his trade.

Look closely

- Find the teapot. How did Copley make the silver look shiny?
- Find the engraving tools on the table. What would Revere do with them next?
- Find the reflections in the polished table. What is reflected there?

Talk about it

1. Why might a craftsman want to be painted at work instead of in his best coat?
2. Where do you think Revere would stamp his mark on this teapot when it was finished?

HANDS-ON: MAKER'S MARK, LABEL AND PACKAGE

Design a logo, an honest label and a simple package for your product.

You will need

- Plain paper, a pencil, a black fine marker and two colored markers
- Cardstock or sticker paper for labels
- Small clear bags, paper, ribbon or string

Steps

1. Sketch six small logo ideas, each about 1 inch across: initials, a simple object, a shape. Use only black.
2. Choose the best two. Redraw each 3 inches across and again $\frac{1}{2}$ inch across. Cross out any that cannot be read when small.
3. Draw a **label layout**: a rectangle about 2 by 3 inches with labeled boxes for Logo, Product name, Maker, Materials, Care, Price. Then make the real label from your layout.
4. Package one item. Draw a diagram of the finished package from the front and label each part (bag, label, tie, card).
5. Show a parent your label and check together that every word on it is true.

Check your work

- My logo works in one color and is readable at $\frac{1}{2}$ inch.
- My label has name, maker, materials, care and price, and every word is true.
- My package protects the product, and my diagram is labeled.

FIELD NOTEBOOK

1. **Notebook entry: My mark.** Write a paragraph about your logo: what it shows, why you chose it, and what promise it makes to the buyer. Mention Paul Revere's mark or the hallmark in your answer.
2. Draw your final logo at large and small sizes and paste in a sample label.

Did you know? British hallmarks can include a date letter, a different letter for each year, so an expert can tell the year a piece of silver was assayed. Goldsmiths' Hall in London still tests and marks gold and silver today, more than 700 years after the law of 1300.

Goes deeper in. Art, "Lettering and Design," and History, "Colonial America and the Revolution" (coming soon).

For families. Sources: The Goldsmiths' Company (history of hallmarking: statute of 1300, makers' marks from 1363); Museum of Fine Arts, Boston (Copley, *Paul Revere*, 1768; Revere silver); FTC Care Labeling Rule (16 CFR 423, adopted 1971); Uneeda Biscuit and the In-er-seal package, 1898. Do not let children put a home address or phone number on labels; a family business name is enough, or an email address you control.

PRACTICE

1. **EASY** Where does the word "hallmark" come from?
2. **EASY** Name four things an honest label tells the buyer.

3. **MEDIUM** How many years passed between the English silver law of 1300 and the law requiring makers' marks in 1363? And between 1363 and Revere's portrait in 1768?
4. **MEDIUM** Give three tests a good logo should pass.
5. **CHALLENGE** Labels cost \$0.04 each, bags \$0.06 and ribbon \$0.05 per item. You have already priced your bookmark at \$2.50 with a true cost of \$1.86. If you add packaging without changing the price, what is your new profit per bookmark?

Make it a game • Whose Mark?. Each player secretly designs a one-color maker's mark on a small card. Shuffle the cards and turn them over one at a time for two seconds only. Players write down whose mark they think each one is. A mark that everyone recognizes in two seconds wins a point for its maker, and for good design.

Scripture. "A good name is rather to be chosen than great riches, and loving favour rather than silver and gold." (Proverbs 22:1, KJV)

A logo is only as good as the name behind it. Honest labels and good work build a good name, and Scripture counts that as more precious than silver and gold.

Practice: answers

1. From Goldsmiths' Hall in London, where gold and silver were tested and stamped.
2. Any four: product name, maker, materials, care, price.
3. 63 years; then 405 years.
4. It works in one color; it can be read when very small; it can be recognized at a glance.
5. Packaging: $\$0.04 + \$0.06 + \$0.05 = \0.15 . New cost: $\$1.86 + \$0.15 = \$2.01$. Profit: $\$2.50 - \$2.01 = \$0.49$ (down from \$0.64).

4.7 A CRAFT-FAIR TABLE OR A FAMILY “SHOP”

OBJECTIVES

- Plan and draw a sales table so products are easy to see, reach and pay for.
- Make change correctly by counting up from the price.
- Greet and serve customers politely and honestly, with a parent’s supervision.

Warm-up. Think of a market, fair or bake sale you have visited. Which table did you walk up to first? What made you stop: color, height, a sign, a friendly face?

Video slot. Video coming. How to set up a craft-fair table; making change by counting up; history of markets and fairs. Search approved channels (Junior Achievement, a 4-H channel, Khan Academy “counting money”); preview first.

KEY TERMS

fair

A gathering, often yearly, where many sellers set up stalls and buyers come from around the region.

display

The way products are arranged so customers can see and reach them.

float

A small amount of change (coins and small bills) in the cash box at the start, so you can make change.

making change

Giving back the right amount when a customer pays more than the price.

customer service

Treating buyers with courtesy, honesty and help, before and after they buy.

CORE IDEAS

Markets and fairs are among the oldest ways makers have met buyers. In the 1100s and 1200s the great Champagne fairs in France drew merchants from Italy, Flanders and beyond, each fair lasting several weeks. The Striezelmarkt in Dresden, Germany, a Christmas market, is first recorded in 1434 and is still held today. In America, the Berkshire Agricultural Society in Massachusetts held a cattle show and fair in 1811 that is often called the first county fair. Church bazaars, farmers’ markets and craft fairs carry on the same tradition.

The apostle Paul worked a craft too. In Corinth he stayed with Aquila and Priscilla, “and wrought: for by their occupation they were tentmakers” (Acts 18:3). He supported himself with his hands so that he would not be a burden to the churches (1 Thessalonians 2:9). Honest selling of good work is a calling a Christian can do with a clear conscience.

A good **display** follows a few rules. Use **height**: put a box or crate under a cloth so some items stand at eye level, not all flat on the table. Group items by **product line**. Put your best piece in front as the “hero.” Price every item or group plainly; many people will not ask. Hang a simple sign with your logo. Leave the front edge clear enough for customers to pick things up, and keep spare stock under the table.

Bring a cash box with a **float**, such as \$20 in ones, quarters and a few fives, and keep it with a parent. To **make change**, count up from the price. If an item is \$2.50 and the customer gives \$5.00, hand back coins and bills while saying, “Two-fifty... three... four... five.” That is \$2.50 in change, and the customer can watch it add up. Write each sale on a tally sheet as it happens; you will need it for your books in the next stop.

Customer service matters as much as the product. Look up, smile and greet people: “Good morning! These bookmarks are made with flowers from our garden.” Answer questions truthfully, including “No, it isn’t waterproof.” Do not pressure anyone. Thank people whether they buy or not. If an item turns out to be flawed, offer to replace it.

If a public fair is not possible, open a family “shop” at home: invite relatives, neighbors or a church group for an afternoon, or set up a table at a family gathering. The same rules apply: a planned table, clear prices, honest change and kind service.

PICTURE STUDY



The Cloth Market in 's-Hertogenbosch, Unknown Netherlandish painter, About 1530 · Oil on panel · Het Noordbrabants Museum, 's-Hertogenbosch, Netherlands
Wikimedia Commons · Public domain

The guild of cloth sellers and cloth workers of 's-Hertogenbosch ordered this painting. It shows their market from above, with rows of cloth stalls in the great square. In front, Saint

Francis, the guild's patron, hands out cloth to the poor. One of the houses on the square, a white house with a stepped gable, belonged to the painter Hieronymus Bosch.

Look closely

- Find the rows of cloth stalls. How are they arranged so buyers can walk between them?
- Find the well and the pillory, the post where cheats and wrongdoers were punished in public.
- Find the people receiving cloth in the front. Who is giving it?

Talk about it

1. Why would a market place the pillory where every seller could see it?
2. Why do you think the guild wanted giving to the poor in the same picture as its market?

Safety first. Selling is done only with a parent present the whole time. The cash box stays with an adult. Never go anywhere with a customer, never give out your address or phone number, and ask a parent before taking any payment other than cash. Check with a parent about local rules, permits or fees for fairs and markets.

HANDS-ON: PLAN AND OPEN YOUR TABLE

Draw a plan of your table from above, practice making change, then sell for real or hold a family shop.

You will need

- Graph paper, ruler and colored pencils
- A tablecloth, a box or crate for height, your price signs and logo sign
- A cash box with a float, a tally sheet and a pencil

Steps

1. Measure the table you will use. On graph paper, draw it from above to scale (for example, 1 square = 6 inches).
2. On the plan, draw and label: **Hero item**, each **product group**, **Raised display**, **Price signs**, **Logo sign**, **Cash box**, **Spare stock** (under the table) and **Customer side** and **Seller side**.
3. Practice making change with a parent ten times, counting up aloud, using real coins and bills.
4. Set up the table to match your plan. Ask a family member to walk past and tell you what caught their eye first.
5. Sell for a set time, marking every sale on your tally sheet.
6. Parent sign-off before selling: I have checked the plan, prices, place and any rules or fees, and I will be present the whole time. Parent signature _____ Date _____

Check your work

- My table plan is drawn to scale with every part labeled.
- I made change correctly by counting up.
- I greeted customers, answered honestly and recorded every sale.

FIELD NOTEBOOK

1. **Notebook entry: Market day.** Write a paragraph about your table or family shop: where and when it was, what sold best, one thing a customer said, and one thing you would change next time.
2. Paste in your table plan and your tally sheet.

Did you know? Dorcas (Tabitha) of Joppa was a Christian woman “full of good works and almsdeeds” who made coats and garments for widows. When she died, the widows wept and showed Peter the clothes she had made, and God raised her to life through Peter (Acts 9:36–41). Many makers set aside part of their goods or earnings to give, as she did.

Map or diagram. On a map of Europe, find Troyes and Provins in Champagne (France), Dresden (Germany) and 's-Hertogenbosch (Netherlands). Then find Pittsfield, Massachusetts, on a map of the United States. Label each with its market or fair and its date.

Goes deeper in. Arithmetic, “Money and Making Change,” and History, “Medieval Towns, Fairs and Trade” (coming soon).

For families. Sources: Acts 9:36–41; 18:3; 1 Thessalonians 2:9 (KJV); Het Noordbrabants Museum, *The Cloth Market* (anonymous, about 1530); Dresden Striezelmarkt (first recorded 1434). The 1811 Berkshire fair is commonly called the first American county fair, but claims differ, so the stop says “often called.” Rules for children selling (permits, sales tax, fair fees) vary by place; please check them before a public sale.

PRACTICE

1. **EASY** What craft did Paul, Aquila and Priscilla share?
2. **EASY** What is a float?
3. **MEDIUM** An item costs \$3.25. The customer pays with a \$10 bill. Count up to give change. How much change?
4. **MEDIUM** Give three rules for a good display.
5. **CHALLENGE** You start with a \$20.00 float. You sell 9 bookmarks at \$2.50 and 2 three-packs at \$6.00. How much money should be in the cash box at the end?

Make it a game · Count Up Shop. Set up a pretend shop with priced items and real or play money. Customers pay with round bills (\$1, \$5, \$10, \$20). The shopkeeper must count up aloud. If the customer catches a mistake, they swap places. Play until each person has made change correctly five times in a row.

Scripture. “And because he was of the same craft, he abode with them, and wrought: for by their occupation they were tentmakers.” (Acts 18:3, KJV)

The great apostle Paul earned his living by a trade and did it alongside other Christian makers. Working with your hands and selling honestly is honorable work.

Practice: answers

1. They were tentmakers (Acts 18:3).
2. A small amount of change put in the cash box at the start so you can make change.
3. From \$3.25: a quarter to \$3.50, two quarters to \$4.00, a dollar to \$5.00, a five to \$10.00.
Change: \$6.75.
4. Any three: use height; group by product line; put the best item in front; price everything plainly; add a logo sign; keep the front clear; keep spare stock under the table.
5. $9 \times \$2.50 = \22.50 ; $2 \times \$6.00 = \12.00 ; sales total \$34.50. Box: $\$20.00 + \$34.50 = \$54.50$.

4.8 KEEP THE BOOKS: SALES, COSTS AND PROFIT

OBJECTIVES

- Keep a simple ledger of money in (sales) and money out (costs).
- Work out profit with the formula $\text{Revenue} - \text{Costs} = \text{Profit}$, and find a break-even point.
- Make a plan for using profit faithfully: giving, saving and reinvesting.

Warm-up. Guess: if you sold 20 bookmarks for \$2.50 each, how much money did you make? Now think: is that all profit? What is missing from the answer?

Video slot. Video coming. Bookkeeping basics for kids: ledgers, revenue, expenses and profit; Luca Pacioli and double-entry bookkeeping. Search approved channels (Khan Academy, Junior Achievement, a museum or university history channel); preview first.

KEY TERMS

ledger

A book or sheet where every amount of money in and out is written down in order, with dates.

revenue

All the money that comes in from sales, before any costs are taken out.

expense

Money spent to run the business, such as materials, packaging and fees.

break-even point

The number of sales at which revenue exactly equals costs; every sale after it earns a profit.

double-entry bookkeeping

A method in which every amount is recorded twice, as a debit and a credit, so the books can be checked for mistakes.

CORE IDEAS

Merchants have kept written accounts for thousands of years; some of the oldest writing in the world, on clay tablets from Mesopotamia, is records of grain, sheep and silver. In 1494 a Franciscan friar and mathematician, Luca Pacioli, published in Venice a great arithmetic book, the *Summa de arithmetica*. One section explained the “method of Venice”: **double-entry bookkeeping**, in which every amount is entered twice, once as a debit and once as a credit, so that the two sides must balance. Pacioli did not invent it, but his clear explanation spread it across Europe. Pacioli was also a friend of Leonardo da Vinci.

You do not need double entry for a small craft business, but you do need a **ledger**. Use one page with columns: Date, What, Money in, Money out. Write every sale (from your tally

sheet) as money in. Write every purchase, bag, label and table fee as money out. Keep your receipts in an envelope. Write things down the same day; memory is a poor bookkeeper.

At the end, add the columns. All money in is your **revenue**. All money out is your **expenses**. Then use the most important formula in business: **Revenue – Costs = Profit**. Say you sold 20 bookmarks at \$2.50: revenue \$50.00. You spent \$15.00 on materials and packaging and paid a \$5.00 table fee: expenses \$20.00. Profit: $\$50.00 - \$20.00 = \$30.00$. (If you are paying yourself for your time, that pay is also a cost; if not, the \$30.00 is what your time earned.)

Now find the **break-even point**. If each bookmark costs about \$0.75 in materials and packaging and sells for \$2.50, each sale brings in \$1.75 above its own materials. The \$5.00 table fee is covered after $\$5.00 \div \$1.75 \approx 2.9$, so the third sale. From there on, every sale adds profit. Knowing your break-even point tells you whether a fair is worth the fee.

Good books also tell the truth when the news is bad. If you lost money, the ledger shows where: a fee too high, prices too low, too much stock left over. That is how makers learn. Jesus said, “He that is faithful in that which is least is faithful also in much” (Luke 16:10). Keeping honest books for a small table of bookmarks trains the habits a person will need with larger things.

Finally, decide what profit is for. Many Christian families teach a simple plan: give first (Proverbs 3:9, “Honour the LORD with thy substance, and with the firstfruits of all thine increase”), save some, and use the rest to buy materials for the next batch. Profit used faithfully is not the end of the business; it is the seed of the next round of work.

PICTURE STUDY



The Merchant Georg Gisze, Hans Holbein the Younger, 1532 · Oil on oak panel · Gemäldegalerie, Staatliche Museen zu Berlin
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Georg Gisze was a German merchant from Danzig who worked at the Steelyard, the London trading post of the Hanseatic League, a league of trading cities around the Baltic and North Seas. Holbein filled the room with the tools of trade: letters addressed to Gisze, account books, a small set of scales, a seal for stamping letters, pens and an inkwell, and a clock. Every object shows a merchant who keeps careful records.

Look closely

- Find the scales. Why would a merchant keep scales on his desk?
- Find the letters and papers stuck behind the strips on the wall. What do they tell you about his work?
- Find the clock and the glass vase of flowers. What might they remind the merchant about time?

Talk about it

1. If you could see Gisze's ledger, what kinds of entries would you expect to find?
2. How is your own ledger like a merchant's desk in 1532?

HANDS-ON: LEDGER AND PROFIT SHEET

Keep a ledger for your sale (real or family shop), work out your profit and draw a profit chart.

You will need

- Your tally sheet and receipts from Stops D3-D7
- Lined or graph paper, a ruler and a calculator
- Colored pencils and an envelope for receipts

Steps

1. Rule a ledger with four columns: Date, What, Money in, Money out. Enter every purchase and every sale in date order.
2. Add the Money in column (revenue) and the Money out column (expenses). Work out $\text{Revenue} - \text{Expenses} = \text{Profit}$, and circle it.
3. Find your break-even point: $(\text{fees and fixed costs}) \div (\text{price} - \text{materials cost per item})$. Write how many sales it took.
4. Draw a **profit chart**: a bar graph with three bars labeled Revenue, Expenses and Profit, with a dollar scale up the side and the amount written on top of each bar.
5. With a parent, divide your profit into Give, Save and Next batch. Write the amounts on the sheet.
6. Parent sign-off: I have checked the ledger and the money matches the cash box. Parent signature _____ Date _____.

Check your work

- Every sale and purchase is in my ledger with a date.
- My profit is worked out correctly and my profit chart is labeled.
- I made a plan to give, save and reinvest.

FIELD NOTEBOOK

1. **Notebook entry: What the books told me.** Write a paragraph about your results: revenue, expenses, profit and break-even point. What would you change about price, product or costs next time, and why?
2. Paste in your profit chart and a copy of your ledger.

Did you know? Bookkeepers once wrote expenses in red ink and income in black. That is where the phrases “in the red” (losing money) and “in the black” (making a profit) come from.

Map or diagram. On a map of Europe, find Venice, where Pacioli’s book was printed in 1494, and trace the Hanseatic route from Danzig (Gdańsk) through the Baltic and North Seas to London, where Giszke worked.

Goes deeper in. Small Business & Economics, “Keeping the Books” and “Profit and Loss,” and Arithmetic, “Money Problems” (coming soon).

For families. Sources: Luke 16:10; Proverbs 3:9 (KJV); Luca Pacioli, *Summa de arithmetica, geometria, proportioni et proportionalita* (Venice, 1494), section “Particularis de computis et scripturis”; Gemäldegalerie Berlin, Holbein, *Georg Giszke* (1532). Double entry was in use in Italian cities before 1494; Pacioli’s book is the first printed explanation. The give–save–reinvest split is a family decision; the stop suggests no fixed percentages. The red-ink origin of “in the red” is widely given but not precisely dated.

PRACTICE

1. **EASY** Write the profit formula.
2. **EASY** Who published the first printed explanation of double-entry bookkeeping, where and when?
3. **MEDIUM** You sold 14 cards at \$2.00 and 6 bookmarks at \$2.50. You spent \$18.00. What were your revenue and your profit?
4. **MEDIUM** Your revenue was \$12.00 and your expenses were \$15.00. What does that mean, and is the business “in the red” or “in the black”?
5. **CHALLENGE** A fair charges a \$10.00 table fee. Each bracelet sells for \$5.00 and costs \$1.00 in materials. How many must you sell to break even? What is your profit if you sell 8?

Make it a game • Balance the Books. A parent makes a stack of 10–15 slips, each a short business event (“Sold 3 bookmarks at \$2.50,” “Bought ribbon, \$3.00,” “Paid table fee, \$5.00”). Players take turns drawing a slip and writing it in the right column of a

shared ledger. When the stack is gone, everyone works out the profit alone. All who agree with the parent's answer win; if answers differ, find the mistake together.

Scripture. "He that is faithful in that which is least is faithful also in much: and he that is unjust in the least is unjust also in much." (Luke 16:10, KJV)

Jesus taught that faithfulness in small things shows what a person will be in great things. Honest books for a small craft table are practice in that faithfulness.

Practice: answers

1. Revenue – Costs (expenses) = Profit.
2. Luca Pacioli, in Venice, in 1494.
3. Revenue: $14 \times \$2.00 = \28.00 , plus $6 \times \$2.50 = \15.00 , total $\$43.00$. Profit: $\$43.00 - \$18.00 = \$25.00$.
4. $\$12.00 - \$15.00 = -\$3.00$: a loss of \$3.00. The business is in the red.
5. Each sale covers $\$5.00 - \$1.00 = \$4.00$. $\$10.00 \div \$4.00 = 2.5$, so you break even on the 3rd sale. Selling 8: revenue $\$40.00$, costs $\$8.00 + \$10.00 = \$18.00$, profit $\$22.00$.

TRAIL 4 BADGE QUIZ

The badge quiz is optional. The student answers in writing, using complete sentences for word questions and showing work for number questions. Four right out of five earns the first badge; four right out of six earns the second. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1-5)

1. Who were Bezaleel and Aholiab, and what was their tribe and work? Name one thing their story teaches a maker.
2. Name the five tests for choosing a product. Which one do beginners most often skip?
3. A roll of ribbon costs \$4.00 and makes 50 bookmarks. Paper for one bookmark costs \$0.20. Labor is \$1.00 and overhead is \$0.25 per bookmark. What is the true cost of one bookmark (ignore waste)?
4. An item costs \$2.40 to make. What is the price with a 25 percent markup? Why must a price be above cost?
5. You inspected 40 bookmarks and found 6 with defects. What is the defect rate? What should you do next?

Badge quiz 2 (Stops 6-8)

6. What is a hallmark, and where does the word come from?
7. List five things an honest label should tell the buyer.
8. A customer buys an item for \$1.75 and pays with a \$5 bill. Show how to count up the change. How much is it?
9. Name three rules for a good craft-table display.
10. Revenue was \$64.00. Materials cost \$22.00 and the table fee was \$8.00. What was the profit?
11. Who was Luca Pacioli, and why is he remembered?

TRAIL CERTIFICATE: MY SMALL BUSINESS BOOK AND TRAIL D CERTIFICATE

Gather the work from all eight stops into one “business book” with a cover showing your logo, your name and the dates: the tabernacle plan, product survey and graph, cost sheet and cost bar, price list and price ladder, quality checklist and inspection diagram, label and package diagram, table plan and tally sheet, and ledger and profit chart.

Write a one-page report: “What I Made, What It Cost, What I Earned and What I Learned.” Include your product line, your prices, your profit and how you gave, saved and reinvested.

When the book is done, a parent reviews the ledger and signs the Trail D certificate.

- **Accurate numbers:** Costs, prices, defect rates and profit are worked out correctly, with the work shown.
- **Honest dealing:** Prices are plainly marked and above cost, labels are true, flaws are disclosed and the ledger matches the cash box.

- **Quality of work:** The product meets a written standard, and the student fixed the causes of defects.
- **Clear records and diagrams:** Charts, diagrams and plans are neat, labeled and kept in order in the Field Notebook.

Answer key

1. Bezaleel of Judah and Aholiab of Dan were the craftsmen God named and filled with skill to build the tabernacle (Exodus 31:1-6). Any one lesson: skill is a gift from God; skills should be taught; materials should be counted honestly; work should be inspected.
2. Skill, repeatability, cost, time and demand. Beginners most often skip demand (finding out whether anyone wants it).
3. Ribbon: $\$4.00 \div 50 = \0.08 . Total: $\$0.08 + \$0.20 + \$1.00 + \$0.25 = \$1.53$.
4. $\$2.40 \times 0.25 = \0.60 ; price \$3.00. Below cost, the maker loses money on every sale.
5. $6 \div 40 = 15$ percent. Find the most common defect and fix its cause in the process; repair what can be fixed and sell flawed items only as plainly marked seconds, or give them away.
6. An official mark stamped on gold or silver to show its purity; it comes from Goldsmiths' Hall in London.
7. Product name, maker, materials, care and price.
8. A quarter to \$2.00, three ones to \$5.00. Change: \$3.25.
9. Any three: use height; group by product line; put the best item in front; price everything plainly; use a logo sign; keep the front clear; keep spare stock under the table.
10. $\$64.00 - (\$22.00 + \$8.00) = \$64.00 - \$30.00 = \34.00 .
11. A Franciscan friar and mathematician whose 1494 book, printed in Venice, gave the first printed explanation of double-entry bookkeeping.