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Cadettes Who Build



Everywhere you go, there are so many buildings all around you. But how exactly does a building get-well-built? Many people work together to construct each building you see—featuring a wide variety of unique jobs within the construction industry! First, a building has to be designed, then supplies are purchased, a construction plan is created, and appropriate safety measures are established! After all of those tasks are completed, you can start to build!

Steps:

1. Design and Coordination
2. Cost and Estimation
3. Planning
4. Safety and Site Management
5. Trades

Purpose:

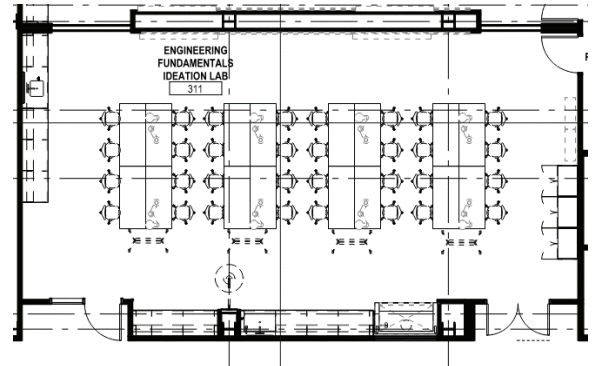
When I have earned this badge, I will understand the steps of the construction process, different construction careers, and how I might go about building something myself.

Step 1: Design and Coordination

Before starting construction, you have to figure out what you want to build! The first step in construction is brainstorming your building's **design**. Designers think about what a building could look like and where everything in it should go. **Engineers** and **architects** also help in this step.

You can visualize your design by creating a **model**! Many designers use computer programs to make digital models of their buildings. One type of 2D model is a technical drawing called a blueprint. An architectural blueprint shows the layout of the rooms and overall appearance, and they are designed to be to-scale, meaning they are carefully made to match the actual measurements. These structural plans detail the structure's framing and support, use math and physics principles to ensure the design is structurally sound, and may include mechanical, electrical, and plumbing elements.

Coordination helps to make sure the design of our building makes sense.



This blueprint (above) was the plan for this room (below).



Activity



Model and vision boards.

Create a **2D** model of a restaurant showing the location of your dining area, kitchen, restrooms, and any other amenities you want to include. Next, create a vision board and surround your model with some images to visualize the design, theme, color scheme, etc. Use pictures from magazines or make a collage on the computer. The design can be whatever you want it to be, and you don't have to worry about the cost of any supplies, so go all out!



Take a look into history.

Find a local historic building to tour and learn about the materials used in construction and the popular design choices when it was built. Once you've arranged your visit, make a list of questions to bring with you. Ask your tour guide the questions or do some independent research to find out what tools and materials were used at that time and why. Do you feel the materials enhance or take away from the visual design of the building? If there isn't a historic building available, head to the public library or city/town hall to check out any planning documents, floor plans, or any other artifacts your librarian or public official can provide.



Build a frame.

In construction, framing determines how a structure will be built by outlining the shape of materials that will be used and how they will be put together. The type of frame you use is an important decision because it plays a role in the strength of the structure. For example, if you live in a place with hurricanes or earthquakes, your structure may require a braced frame construction. Some structures get their name from their shape, like an A-frame building shaped like a triangle. If you've ever built a fire, you've probably tried a variety of different framing techniques! Construction and fire-building are similar because they incorporate A-frames, log cabins, pyramids, and other framing styles. Do some research on popular framing styles for fires and discuss, make a list, or create a chart detailing the pros, cons, and purposes of each. If you have the opportunity, create a structure using found materials and try out these new methods.

Step 2: Cost and Estimation

Huge buildings can cost a lot of money because construction companies have to purchase resources and hire many people to work on them. To build this South Station redevelopment, you would have to sell more than 199,400,000 packages of Girl Scout cookies.

To determine the cost of everything needed to build a project, you must complete an **estimation**. Then, a **budget** is used to keep track of where and on what money is spent. This way, companies always know if they have enough left in their budget to finish the construction project.

You can figure out the cost of materials using **unit** prices and the total amount of each material you'll need. For example, if you need eight gallons of paint, and each gallon of paint costs \$20, your total paint cost will be \$160. If you are working on a big construction project, you may need to hire a contractor to help you. A **contractor** performs a specialized task that you may not have the skills to complete. Because of their expertise, you will pay this person well, so be sure to account for their labor cost in your budget. It's always good to make sure you're staying under budget and getting the best value out of your money! **Renovation** can be much less costly than building something from scratch because it starts with an existing building. With some minor changes, you can make something old feel new!



Activity



Renovate your room.

Sometimes, we all need a refresh! How much would it cost to renovate your room to fit your style? This is your opportunity to design whatever you want, even if you share a room with someone else. You could paint the walls, change the flooring, hire an electrician to add cool lighting, or even build a bookshelf or custom closet. Define your goal, make a list of materials, and head online or to a local hardware store to start calculating the cost. If any special skills are needed to do your renovations, you'll have to pay an expert to get the job done. Use the **Estimation worksheet (Worksheet 2)** to estimate your costs and set out a plan for your new room.



Plan a gazebo.

Gazebos are common structures in public parks and community spaces because they provide a shaded space to sit and gather. Imagine if someone asks you to help design one for your community. You will need to make some decisions about the design, including size and location. Is it accessible for persons with disabilities? Do you want to wire it for electricity for lighting or to play music? These are some considerations to address. Next, you will need to research the cost of the materials to build your gazebo. Don't forget to account for tradespeople's labor in your budget! For example, you might need an electrician if you are adding lighting. Use the **Estimation worksheet (Worksheet 2)** to estimate your costs and set out the plan for your gazebo.



Design a sports shed.

What would it cost to build a shed to store sports equipment at your school? As a small group, first list all the types of equipment your school has for each sport played on the fields. Then, decide on the best way to store the equipment and how big the shed will need to be. For example, will you hang bats and lacrosse sticks on the wall and store soccer balls on shelves? Consider drawing a model to design your space and estimate the length and height of your walls. After that, think about the design of your shed and the materials you will need to buy. Bring it all together by making a list of materials, including their size and quantity. Finally, go online or to a hardware store to calculate the total cost of your shed. Don't forget to include labor costs! Use the **Estimation worksheet (Worksheet 2)** to estimate your costs and set out the plan for your sports shed.

Step 3: Planning

In construction projects, some things need to be built before other things can be accomplished. For example, you need to build your walls before painting them! The order between these two things is logic. Builders use logic in **planning** to figure out how a structure should be built.

It's a planner's job to figure out which parts of a project need to be built before other ones by stringing together a long sequence of tasks. If anything in that sequence becomes delayed by external factors, like a rainstorm on the roof-building day, then the steps after it will also be delayed. Then, the whole project will be off-schedule! This process is called a **Critical Path**.

Planners want a building completed on time, by the initial date scheduled, or by the deadline. They keep track of **float**, which is the amount of time a step in the building process can be delayed before the deadline is impacted!

Activity



Choices – do one:



Make a plan as a group.

Like builders, Girl Scouts make plans with big goals in mind. Both in construction and in Girl Scouts, these plans can take more than one year to execute. Does your group have any big plans relating to selling cookies, camping, travel, community service, or something else? Time management and critical paths are essential tools to set you up for success. As a group, discuss a long-term plan you are working on and write out all the steps along the way. You may need to sell a certain amount of cookies to raise enough money for a camping trip or an exciting community service project. The order of these steps is important because you might need to do fundraising before you can travel or purchase materials. How much float do you have? If your trip is planned right after cookie season ends and you don't make enough money selling cookies, do you have enough time to hold an additional fundraiser? Work together to make your plan.



Know your measurements.

In construction, there can be a lot of math involved. From pricing out materials to understanding how much wood you need to buy—it's important to know your measurements for your project. Depending on the type of material you are working with, measurements and how you calculate them can differ. Make your best guess with the **Measurement worksheet (Worksheet 3)** and get to know some building materials better.



Plan for success.

Professionals in different roles each use a unique set of skills and tools to do their jobs correctly. Project managers need things like time management and computer software skills, whereas carpenters may need physical tools like saws, nails, or sanding blocks. It's your turn to build a personal toolbox for success! Think about a goal you have or a role you play on a team. What skills and resources do you need to be successful? If you're trying to be a better softball player by the spring, do you need extra time with your coach and teammates? Is your bat the wrong size, and you need to save up for a new one? Use the **Plan for Success worksheet (Worksheet 4)** to make your plan for success.

Step 4: Site Management and Safety

When you imagine a construction worker, what are they wearing? And what do you imagine a construction site looks like?

A construction project of any size can be dangerous if safety isn't the top priority. That's why construction workers wear **personal protective equipment (PPE)**, such as hard hats, gloves, goggles, and high visibility safety vests. Site safety managers help ensure that all the work on a construction site is done on time and, most importantly, safely. However, it's everyone's responsibility to look out for each other and make sure everyone remains unharmed.

Activity



Choices – do one:



Work together to stay safe.

Form small groups of about 4-6 people. In your small groups, find one volunteer willing to put on a blindfold. The person who is blindfolded will be led verbally by the rest of the group as they perform a simple task, like navigating through a small maze made of safety cones. The rest of the team will give directions to help their teammate complete the task while staying safe. Once the task has been completed, discuss the challenges you faced. How hard was it to give instructions? How did it feel to be helping out someone who couldn't "see" the full picture? Did the blindfolded person feel safe with the rest of the team's guidance?



Play a game of I Spy.

As a group, play a game of I Spy to find and point out unsafe situations. Take a field trip to a public place, look around, and make a mental list of everything that could be hazardous. For example, maybe you go to the hardware store when completing another part of this patch, and you see something that hasn't been properly stored or a ladder left in the middle of an aisle. When you see something unsafe, quiz the people around you by playing a game of I Spy. Or, guess what safety equipment and precautions are necessary when using certain tools you see. You could also play I Spy in your regular meeting space, and troop volunteers could set up some potentially unsafe situations for you to observe.



Learn about tools and safety.

Have you ever used a pocket knife or chisel for woodworking or whittling? What kind of precautions did you need to take to stay safe? Invite an expert to teach you about tool safety and put your knowledge to the test by building something small to benefit your community. Consider an art cart, bench, bookshelf, coat hanging rack, or bike rack that can be given to a preschool, religious community, or afterschool program.

Need ideas? Check out DIY plans from:

Home Depot https://www.homedepot.com/c/diy_projects_and_ideas

The DIY Plan <https://thedioplan.com/category/thedioplan-categories/kids/>

Wood Shop: Handy Skills and Creative Building Projects for Kids by Margaret Larson

Adults: Please review a list of approved hand and power tools in [Safety Activity Checkpoints](#).

Step 5: Trades

What are you an expert on? Is it something you learned by yourself? In school? Or something you learned by helping someone else?

People with **trades** are experts with special knowledge of a specific part of a construction project! An electrician is just one example of a tradesperson—there are so many different skills and types of expertise that you can master! If you can name a part of a building, there's probably a tradesperson with special knowledge to build it.

Every trade works with different materials and tools. Some use a hammer and nails, some work in machines high above the ground, and some create the parts of buildings that make them beautiful!

Activity: Trades Quiz

Are you curious about which trade best suits your personality and interests? Check out these websites, which have detailed descriptions of the trades. You can take an online quiz, like the one on [BYF.org](https://byf.org), to learn more!

<https://byf.org/explore/construction-careers/>

<https://www.skillscompetencescanada.com/en/sector/construction/>

Activity



Choices – do one:



Landing the job.

Pick a trade you are interested in and pretend to apply for an open position. Do some research about what you need to know to be prepared for the job! Do you need any formal education, like an apprenticeship or certification? Finally, create a resume to show you've taken all the proper steps to land the job. Websites like this one can help you get all the details you need. <https://www.byf.org/>



Discover painting: the trade and its tools.

Learn about what a painter does and the tools they use every day. As a bonus, put your new knowledge into action and go out in your community to make a change. Consider painting a mural at the library, school, or local recreation center or applying a fresh coat of paint to a fence or picnic table at your local park. Be sure to get permission for whatever project you want to pursue!

See [Discover Painting worksheet \(Worksheet 5\)](#)



Explore technical high schools.

Certain high schools, known as vocational or technical schools, teach students trades like carpentry and plumbing or prepare them for careers in healthcare, cosmetology, early education, culinary arts, agriculture, manufacturing, automotive services, and more! Look up trade, technical, or vocational schools in your area to see what they offer. Consider going on a tour if there's one nearby.



Congratulations on becoming Cadettes Who Build!

Thank you for your feedback.

Please complete the evaluations below to provide feedback on your experience and receive verification to get your Cadettes Who Build patches:



Adult Survey:
bit.ly/jwbsurvey1



Youth Survey:
bit.ly/jwbsurvey2



Words to Know

Design	a detailed solution showing your ideas or intentions
Engineer	a person trained to design and build a structure safely
Architect	a person who designs buildings and supervises construction
Model	a physical or digital representation of the building or the idea of the building
Coordination	something you must practice to ensure everyone's design solutions fit and work together
2D	when something is flat or has just length and width, like a square
Estimation	a calculation of how much a construction project will cost
Budget	a place to keep track of income and expenses for a set period of time
Unit	a way of measuring quantities of materials needed for building—for example length, weight, or capacity
Contractor	someone hired to work on a specific project for an agreed-upon amount of money
Renovation	when you take something old and make it new to refresh the design or bring a place out of a state of disrepair
Planning	the process of identifying the steps needed to build a structure, splitting them into activities, and ordering them logically
Critical Path	the sequence of activities in a schedule that must be completed on time for the project to stay on schedule; or the sequence of activities in a schedule that must be completed in a particular order
Float	the amount of time that an activity can be delayed without affecting the project completion date
PPE	personal protective equipment; anything someone wears to keep them safe
Trade	a job with a special skill set and specific training
Volume	is a unit of measurement used to calculate the amount of space something occupies

Estimation Worksheet

Use this worksheet to plan out the project of your choice by estimating the costs of the materials and labor involved in the process. Define your project, measurements, and scope, then do the research to estimate the cost. Complete your research online or take a trip to the hardware store.

This worksheet will help you determine the materials and labor costs. To calculate the materials cost, list the special tools or products each tradesperson needs to complete their job and multiply the quantity by the unit price. To calculate the labor, list the project's laborers and multiply their hourly rate by the number of hours estimated to complete their portion of the project.

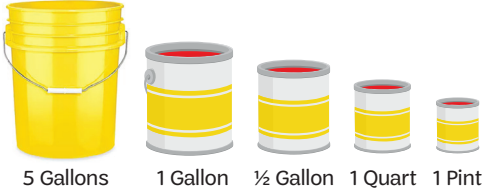
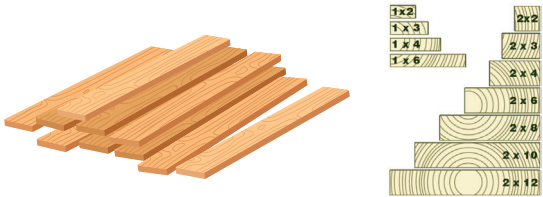
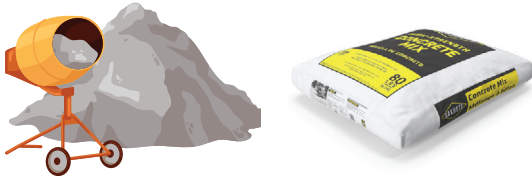

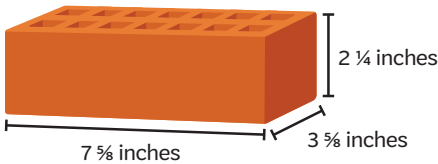
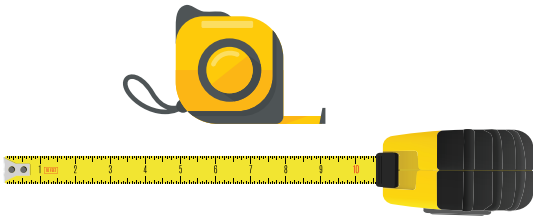
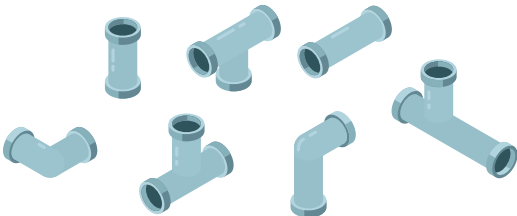
Scope of Work: Materials					Scope of Work: Labor			
Material	Quantity	Unit Price	Total		Laborer	Cost per hour	# of Hours	Total
ex) Paint	2 gallons	\$30	\$60		Painter	\$50	4	\$200

Grand Total _____

Laborer	Cost per hour	Laborer	Cost per hour
Painter	\$50	Roofer	\$75
Carpenter	\$100	Landscaper	\$65
Electrician	\$100	Insulator	\$25
Plumber	\$125	Floor Installer	\$40

Measurement Worksheet

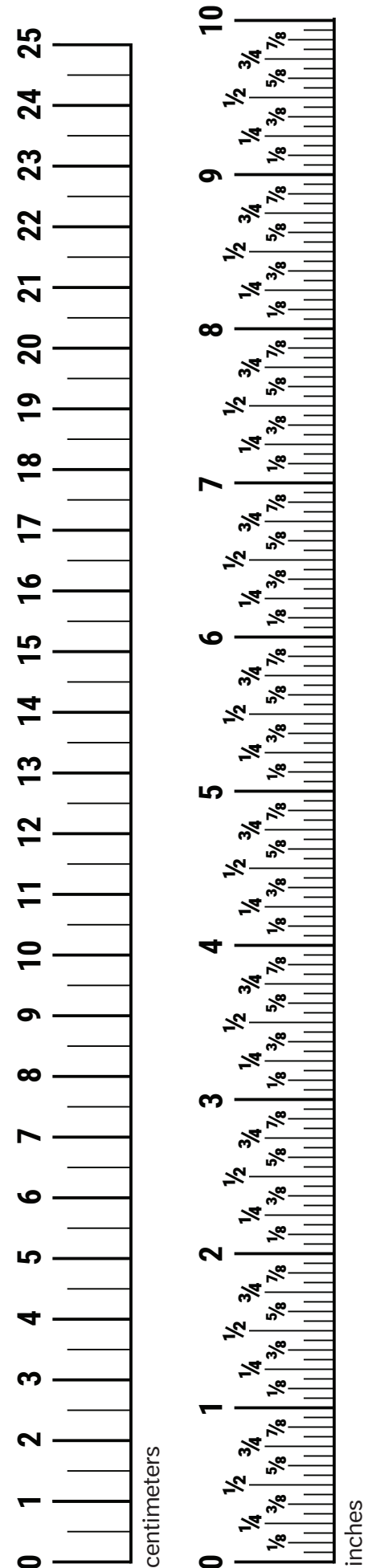
Here are some materials and supplies commonly used in construction. Circle if these measurements refer to weight, **volume**, or length.

Paint	 <p>5 Gallons 1 Gallon ½ Gallon 1 Quart 1 Pint</p>	<p>Paint is sold in buckets or cans. The largest unit of measurement is a gallon and the smallest is a pint.</p> <p>Is this: Weight Volume Length</p>
Lumber		<p>Lumber is often referred to by its measurements, like a “two by four.”</p> <p>Is this: Weight Volume Length</p>
Concrete		<p>Concrete is created with a combination of cement, water, and aggregate. Once mixed, concrete is poured into forms or molds to make sidewalks, stairs, and more.</p> <p>Is this: Weight Volume Length</p>
Nails & Screws		<p>Nails and screws often come in boxes. The box has a lot of numbers on it! One of those numbers indicates how many individual nails or screws are inside the box. What do the other numbers tell you?</p> <p>Is this: Weight Volume Length</p>
Bricks		<p>Brick dimensions are labeled with one measurement per side in inches.</p> <p>Is this: Weight Volume Length</p>
Measuring Tapes		<p>Measuring tapes are expandable rulers! They can be stretched out to make large measurements and then they roll back up into a compact case.</p> <p>Is this: Weight Volume Length</p>
Plumbing Fittings		<p>Plumbing fittings come in all different shapes and sizes. Just imagine the mazes of pipes behind your walls that bring water wherever it needs to go. Not only do you need to know the measurements of the pipe openings, but you also need to make sure they will be long enough!</p> <p>Is this: Weight Volume Length</p>

Measurement Worksheet (p.2)

Next, gather some small items in the room around you. Use a ruler if you have one handy, or use this printout. With a buddy or two, try to guess the measurements of the items you have found, then measure to see how close you are. As a bonus, try guessing measurements in centimeters too! If you have time, you can also do this at a home improvement store with a ruler or measuring tape. Don't cheat by reading the labels, just give it your best guess!

Items	Estimate	Actual Size
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ inches	_____ inches
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters
	_____ centimeters	_____ centimeters



Plan for Success

Brainstorm your own personal plan for success, and be sure to fill your toolbox with the right supplies.

Personal Goal

Example: I want to start my own cupcake business and bake delicious treats that my neighbors and friends will buy for holidays and celebrations.

Timeline

Example: I want my first big party to be my sister's birthday, which is in six months.

Steps

1.

2.

3.

4.

Example: First, I will watch some videos online about the science of baking to improve my cake recipe. This will help me understand where my recipes have gone wrong. Then, I will take a weekend class to learn about frosting and decorating; this will last two months. To practice my new skills, I'll bake at least once a week and share my treats with friends along the way.

Skills & Resources

1.

2.

3.

4.

5.

Example: I will need some help buying ingredients for testing recipes since I won't have paying customers yet. I will definitely need to practice my patience as I learn how to frost cupcakes in different designs. I hope to get feedback and support from my family and friends after sharing my cupcakes with them. I will need to get out there and spread the message to my community about my business. Maybe I should decorate an apron with my business name and take some pictures to share on social media!

Discover Painting

According to Mass.gov, the list below outlines all of the duties that a professional painter should expect to oversee. Read through this job description together and pay special attention to the tools, materials, and important steps in a painter's daily work that are mentioned. You may refer to the glossary and attached descriptions for clarification.

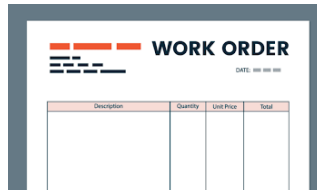
Painter apprenticeship description:

- Applies coats of paint, varnish, stain, enamel, or lacquer to decorate and protect interior or exterior surfaces, trimmings, and fixtures of buildings and other structures.
- Reads work orders or receives instructions from supervisor or homeowner regarding painting.
- Smooths surfaces, using sandpaper, brushes, or steel wool, and removes old paint from surfaces, using paint remover, scraper, wire brush, or blowtorch to prepare surfaces for painting.
- Fills nail holes, cracks, and joints with caulk, putty, plaster, or other filler, using a caulking gun and putty knife.
- Selects premixed paints, or mixes required portions of pigment, oil, and thinning and drying substances to prepare paint that matches specified colors.
- Removes fixtures, such as pictures and electric switch covers, from walls prior to painting, using a screwdriver.
- Spreads drop cloths over floors and room furnishings.
- Covers surfaces, such as baseboards, door frames, and windows with masking tape and paper to protect surfaces during painting.
- Paints surfaces, using brushes, spray guns, or paint rollers.
- Simulates wood grain, marble, brick, or tile effects.
- Applies paint with cloth, brush, sponge, or fingers to create special effects.
- Erects scaffolding or sets up ladders to perform tasks above ground level.
- May also hang wallpaper and fabrics.
- May wash surfaces prior to painting with mildew remover, using brush.



Discover Painting (p.2)

Write the letter of the corresponding description that describes why painters use the following tools and materials.



Work Order ____



Sandpaper ____



Putty Knife ____



Masking Tape ____



Paint Roller ____



Drop Cloth ____



Paint Brush ____



Outlet Covers ____



Caulk/Caulk Tool ____



Varnish ____



Stain ____



Ladder/Scaffolding



Paint ____



Enamel ____

- A** Changes the color of a surface
- B** Creates a protective layer on wood and can be shiny or matte and is mostly transparent
- C** Changes the color of wood by permeating it with pigment
- D** A special type of paint that sticks to and protects metal
- E** Describes all the requirements of a project
- F** Smooths out a surface and removes old paint
- G** Fills in gaps or cracks around windows, doors, floorboards, and ceilings
- H** Flat tool for smoothing out patching agents
- I** Plastic or metal plates that cover up electrical elements
- J** Covers large surfaces that shouldn't get paint on them
- K** Sticks to walls and trim to help painters create smooth edges
- L** Tool for covering small areas precisely with paint
- M** Tool for spreading paint smoothly onto large flat areas
- N** Helps painters safely reach ceilings and high areas

Volunteer Resources

Step 1 - Model and Vision Boards

- This [video](#) describes how to measure a space, draw a floor plan, make the floor plan to scale, and insert furniture.
- Here is a detailed [video](#) about making a digital mood board.
- Or a simpler [video](#) about making a digital mood board.
- Consider getting samples from a hardware store to show paint colors, wood grains, fabrics, and rugs.
- Bring home design magazines to cut out furniture, rugs, pillows, decor, etc.

Step 1 - Build a Frame

- Watch a [video](#) demonstrating braced frames.
- View some [pictures](#) of house framing.
- The first six minutes of this [video](#) show homeowners building an A-frame guest house.
- Share an [article](#) with five types of campfires or another [article](#) with seven types of campfires.
- Watch a [video](#) demonstrating building three types of campfires.

Step 3 - Know your Measurements

You can also do this activity by incorporating some movement.

1. Label three different parts of the room as weight, volume, and length.
2. Have a printout of the picture in the left-hand column or read the description of the construction material in the right-hand hand column.
3. Then prompt your Girl Scouts to travel to the area they think matches the description.

Or you can host a game show where you read out the descriptions and display the pictures, then have contestants raise a handheld fan (or their hand) to answer. Handheld fans can easily be made with tongue depressors or wide popsicle sticks and paper plates.

Step 5 - Landing the Job

- Pull up resume [template](#) examples to teach the typical parts of a resume.
- Share an example job listing from [Suffolk](#) and review the most important parts to look at in order to help the Girl Scouts tailor their resume for their intended position.