Introduction

Exploring Woodworking is designed to assist in learning the fundamentals of working safely and efficiently with hand tools and power tools. In addition, the book acquaints you with the different types of woods and their uses. It also introduces you to the industrial woodworking environment, and describes the technology used today to produce a variety of wood products.

The information included in *Exploring Woodworking* is presented in an easy-to-understand format. New terms are listed at the start of each section and are introduced within that section. This allows you to be introduced to a new term in context, resulting in the best understanding of the material being presented. Safety is stressed throughout the text and is highlighted using a predominant second color. This enables you to easily locate important information regarding the care and safe operation of tools and equipment.

Exploring Woodworking emphasizes the important role that wood and wood by-products play in our everyday lives. Wood is a vital part of our future. Improved technology, conservation, and recycling will be critical to ensuring an adequate supply of wood for the future.

The contents of this book are presented in an orderly and organized manner. Information regarding the materials used in woodworking, safety, and product planning is presented first. Subsequent chapters focus on hand tools, portable power tools, and power woodworking machines, including information on safety and proper use. Updated information in the areas of project construction, wood finishing, lamination, wood bending, and adhesives is also covered. Chapters presenting information on automated manufacturing, entrepreneurship, and career opportunities are also included in this book. Many operations that occur in an industrial setting are different from those that occur in a wood lab. However, the theory and principles of operation remain the same.

The final chapter of *Exploring Woodworking* provides construction details of carefully selected new projects. These projects provide students with exciting, easy, first-time projects to build. A special section also shows simple-to-complex woodworking projects completed by students.

Exploring Woodworking is intended for students in middle schools, junior high schools, and high school career and technology education programs. Since this is a beginning level exploratory woodworking book, it could also be used for adult education classes and by the do-it-yourselfer.

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About the Author

Fred W. Zimmerman was Professor Emeritus from Western Illinois University in Macomb, Illinois. Fred earned several degrees, including a bachelor of science degree from Southern Illinois University, a master of science degree from Kent State University, and a doctorate in Industrial Education from Bradley University in Peoria, Illinois. He had extensive experience as both an instructor and woodworker, and was active in the Illinois Vocational Industrial Clubs of America as a judge in the cabinetmaking and millwork areas. Fred was a member of the Illinois Woodworking Teachers Association and a Life Member of the International Industrial Education Association.

Larry J. McWard is a professor in the Industrial Education and Technology department at Western Illinois University. He has earned several degrees, including a bachelor of science degree in Industrial Education and Vocational Education, and a master of science degree in Instructional Technology (Media) from Southern Illinois University. He has also earned a doctorate in Vocational-Technical Education from The Ohio State University. Larry's work experience includes 20 years of teaching experience at the junior high, high school, and university levels. Courses taught include vocational building trades and cabinetmaking. Larry also has 12 years of work experience as a carpenter, cabinetmaker, and general contractor. Larry is actively involved in the National Association of Industrial and Technical Teacher Educators, Association for Career and Technical Education, and is past-president of the Illinois Woodworking Teachers Association.

Don L. Blazek received his bachelor of science degree in Industrial Education from Fort Hays State University in Hays, Kansas, and his master of science degree at Pittsburg State University in Pittsburg, Kansas. He taught in the Shawnee Mission School District #512, located in Overland Park, Kansas. He taught an exploratory industrial education program consisting of materials and processes (wood and plastics), visual communication (drafting, graphic arts, photography, and video production) and manufacturing processes. He served on two federally funded development projects for the development of pilot industrial education programs for middle/junior high schools for the state of Kansas. This SET (Secondary Exploration of Technology) helped lead to the development of the modular concept of teaching technology education. Don also taught woodworking adult education classes at the local community college and woodworking retail store. Over the span of his teaching career, he was actively involved with the Kansas Industrial Education Association, American Industrial Arts Association, and Skills USA. In 1978 he was selected the Outstanding Industrial Education Teacher for the state of Kansas.

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Reviewers

The author and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Exploring Woodworking*.

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New to This Edition

The following changes have been made to the ninth edition of *Exploring Woodworking* to provide up-to-date information on the latest technology and industrial developments.

- Essential Questions at the beginning of each chapter have been added to get students thinking about the topic before reading the chapter.
- Going Green features have been added to emphasize conservation and recycling practices.
- Images have been updated and added to show current practices and tools.
- Woodworking projects have been updated to reflect current industry trends.
- End-of-Chapter material has been revised and updated to include a Summary and Critical Thinking questions, helping to extend student learning and understanding.

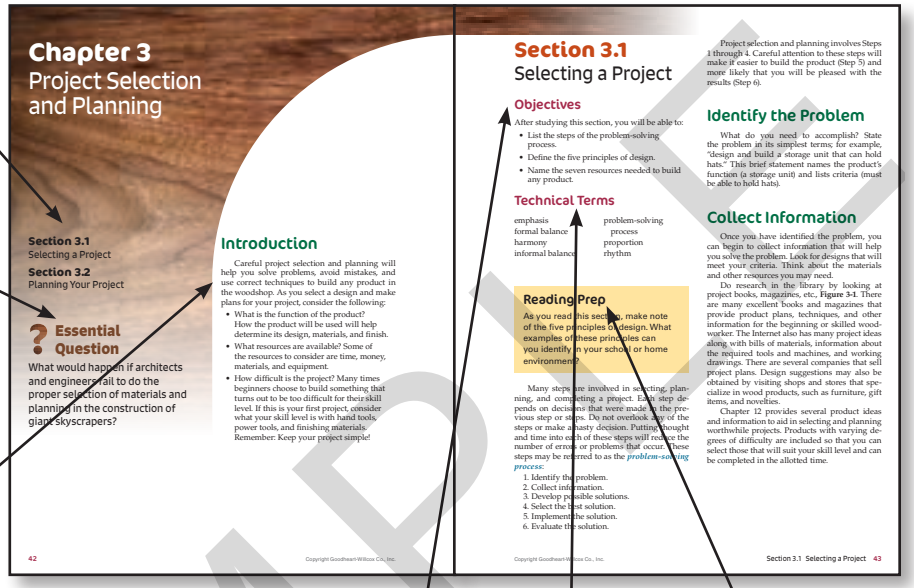
Guided Tour

The instructional design includes student-focused learning tools to help students succeed. This visual guide highlights the features designed for the textbook.

Chapter Outline summarizes the topics that will be covered in the chapter.

Essential Question helps you to connect what you are learning to real-world scenarios.

Introduction provides an overview and preview of the chapter content.



Chapter 3
Project Selection and Planning

Section 3.1 Selecting a Project
Section 3.2 Planning Your Project

Essential Question
What would happen if architects and engineers fail to do the proper selection of materials and planning in the construction of giant skyscrapers?

Introduction

Careful project selection and planning will help you solve problems, avoid mistakes, and use correct techniques to build any product in the woodshop. As you select a design and make plans for your project, consider the following:

- What is the function of the product? How the product will be used will help determine its design, materials, and finish.
- What resources are available? Some of the resources to consider are time, money, materials, and equipment.
- How difficult is the project? Many times beginners choose to build something that turns out to be too difficult for their skill level. If this is your first project, consider what your skill level is with hand tools, power tools, and finishing materials. Remember: Keep your project simple!

Section 3.1
Selecting a Project

Objectives

After studying this section, you will be able to:

- List the steps of the problem-solving process.
- Define the five principles of design.
- Name the seven resources needed to build any product.

Technical Terms

emphasis, formal balance, harmony, informal balance, problem-solving process, proportion, rhythm

Reading Prep

As you read this section, make note of the five principles of design. What examples of these principles can you identify in your school or home environment?

Many steps are involved in selecting, planning, and completing a project. Each step depends on decisions that were made in the previous step or steps. Do not overlook any of the steps or make a hasty decision. Putting thought and time into each of these steps will reduce the number of errors or problems that occur. These steps may be referred to as the *problem-solving process:*

1. Identify the problem.
2. Collect information.
3. Develop possible solutions.
4. Select the best solution.
5. Implement the solution.
6. Evaluate the solution.

Project selection and planning involves Steps 1 through 4. Careful attention to these steps will make it easier to build the product (Step 5) and more likely that you will be pleased with the results (Step 6).

Identify the Problem

What do you need to accomplish? State the problem in its simplest terms; for example, "design and build a storage unit that can hold hats." This brief statement names the product's function (a storage unit) and lists criteria (must be able to hold hats).

Collect Information

Once you have identified the problem, you can begin to collect information that will help you solve the problem. Look for designs that will meet your criteria. Think about the materials and other resources you may need.

Do research in the library by looking at project books, magazines, etc., Figure 3-1. There are many excellent books and magazines that provide product plans, techniques, and other information for the beginning or skilled woodworker. The Internet also has many project ideas along with bills of materials, information about the required tools and machines, and working drawings. There are several companies that sell project plans. Design suggestions may also be obtained by visiting shops and stores that specialize in wood products, such as furniture, gift items, and novelties.

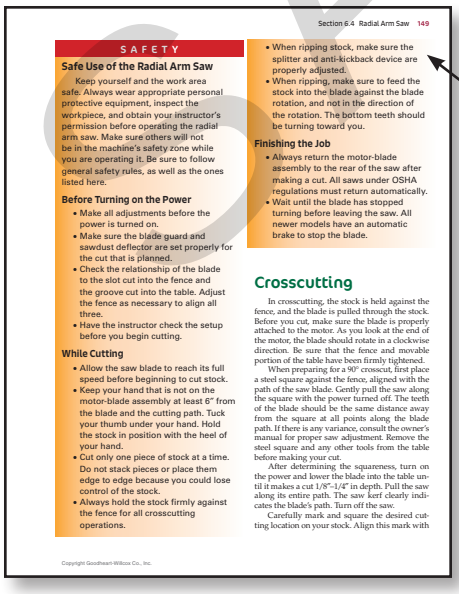
Chapter 12 provides several product ideas and information to aid in selecting and planning worthwhile projects. Products with varying degrees of difficulty are included so that you can select those that will suit your skill level and can be completed in the allotted time.

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Objectives clearly identify the knowledge and skills to be obtained when the chapter is completed.

Technical Terms list the key terms to be learned in the chapter.

Reading Prep helps you prepare to understand the chapter.



SAFETY

Safe Use of the Radial Arm Saw

Keep yourself and the work area safe. Always wear appropriate personal protective equipment, inspect the workpiece, and obtain your instructor's permission before operating the radial arm saw. Make sure others will not be in the machine's safety zone while you are operating it. Be sure to follow general safety rules, as well as the ones listed here.

Before Turning on the Power

- Make all adjustments before the power is turned on.
- Make sure the blade guard and sawdust deflector are set properly for the cut that is planned.
- Check the relationship of the blade to the slot cut into the fence and the groove cut into the table. Adjust the fence as necessary to align all three.
- Have the instructor check the setup before you begin cutting.

While Cutting

- Allow the saw blade to reach its full speed before beginning to cut stock.
- Keep your hand that is not on the motor-blade assembly at least 6" from the blade and the cutting path. Tuck your thumb under your hand. Hold the stock in position with the heel of your hand.
- Cut only one piece of stock at a time. Do not stack pieces or place them edge to edge because you could lose control of the stock.
- Always hold the stock firmly against the fence for all crosscutting operations.
- When ripping stock, make sure the splitter and anti-kickback device are properly adjusted.
- When ripping, make sure to feed the stock into the blade against the blade rotation, and not in the direction of the rotation. The bottom teeth should be turning toward you.

Finishing the Job

- Always return the motor-blade assembly to the rear of the saw after making a cut. All saws under OSHA regulations must return automatically.
- Wait until the blade has stopped turning before leaving the saw. All newer models have an automatic brake to stop the blade.

Crosscutting

In crosscutting, the stock is held against the fence, and the blade is pulled through the stock. Before you cut, make sure the blade is properly attached to the motor. As you look at the end of the motor, the blade should rotate in a clockwise direction. Be sure that the fence and movable portion of the table have been firmly tightened.

When preparing for a 90° crosscut, first place a steel square against the fence, aligned with the path of the saw blade. Gently pull the saw along the square with the power turned off. The teeth of the blade should be the same distance away from the square at all points along the blade path. If there is any variance, consult the owner's manual for proper saw adjustment. Remove the steel square and any other tools from the table before making your cut.

After determining the squareness, turn on the power and lower the blade into the table until it makes a cut 1/8"–1/4" in depth. Pull the saw along its entire path. The saw kerf clearly indicates the blade's path. Turn off the saw.

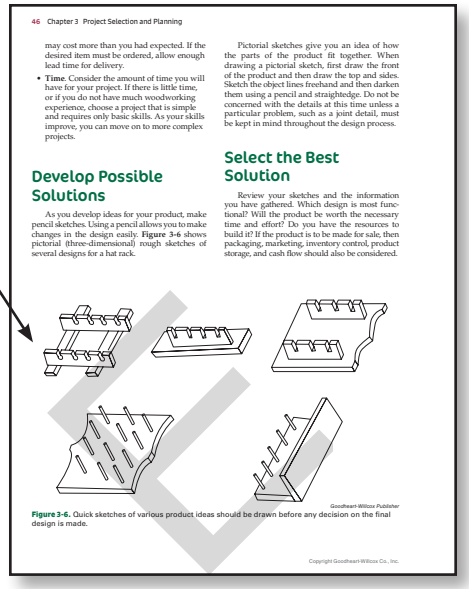
Carefully mark and square the desired cutting location on your stock. Align this mark with

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Safety Notes alert you to potentially dangerous materials and practices.

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Illustrations have been designed to clearly and simply communicate the specific topic.


46 Chapter 3 Project Selection and Planning

may cost more than you had expected. If the desired item must be ordered, allow enough lead time for delivery.

- **Time**. Consider the amount of time you will have for your project. If there is little time, or if you do not have much woodworking experience, choose a project that is simple and requires only basic skills. As your skills improve, you can move on to more complex projects.

Develop Possible Solutions

As you develop ideas for your product, make pencil sketches. Using a pencil allows you to make changes in the design easily. **Figure 3-6** shows pictorial (three-dimensional) rough sketches of several designs for a hat rack.

Pictorial sketches give you an idea of how the parts of the product fit together. When drawing a pictorial sketch, first draw the front of the product and then draw the top and sides. Sketch the object lines freehand and then darken them using a pencil and straightedge. Do not be concerned with the details at this time unless a particular problem, such as a joint detail, must be kept in mind throughout the design process.

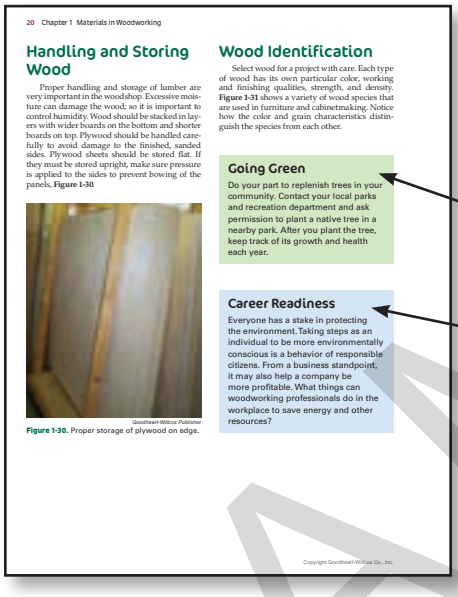
Select the Best Solution

Review your sketches and the information you have gathered. Which design is most functional? Will the product be worth the necessary time and effort? Do you have the resources to build it? If the product is to be made for sale, then packaging, marketing, inventory control, product storage, and cash flow should also be considered.

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Figure 3-6. Quick sketches of various product ideas should be drawn before any decision on the final design is made.

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20 Chapter 1 Materials in Woodworking

Handling and Storing Wood

Proper handling and storage of lumber are very important in the woodshop. Excessive moisture can damage the wood; so it is important to control humidity. Wood should be stacked in layers with wider boards on the bottom and shorter boards on top. Plywood should be handled carefully to avoid damage to the finished, sanded sides. Plywood sheets should be stored flat. If they must be stored upright, make sure pressure is applied to the sides to prevent bowing of the panels, **Figure 1-30**.

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Figure 1-30. Proper storage of plywood on edge.

Wood Identification

Select wood for a project with care. Each type of wood has its own particular color, working and finishing qualities, strength, and density. **Figure 1-31** shows a variety of wood species that are used in furniture and cabinetmaking. Notice how the color and grain characteristics distinguish the species from each other.

Going Green

Do your part to replenish trees in your community. Contact your local parks and recreation department and ask permission to plant a native tree in a nearby park. After you plant the tree, keep track of its growth and health each year.

Career Readiness

Everyone has a stake in protecting the environment. Taking steps as an individual to be more environmentally conscious is a behavior of responsible citizens. From a business standpoint, it may also help a company be more profitable. What things can woodworking professionals do in the workplace to save energy and other resources?

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Going Green notes highlight key items related to sustainability, energy efficiency, and environmental issues.

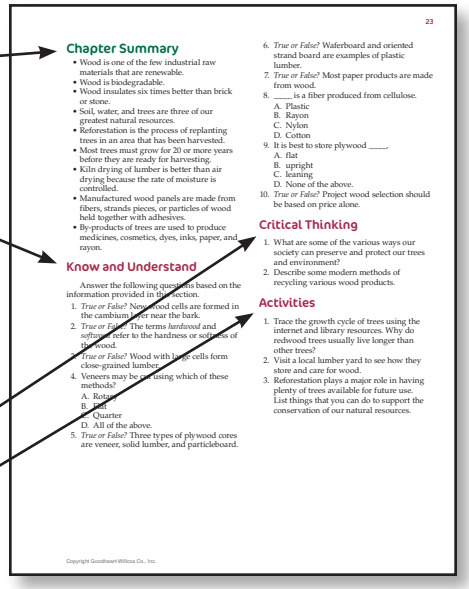
Career Readiness helps you understand what you can anticipate and expect in the workplace.

Chapter Summary provides an additional review tool for you and reinforces key learning objectives.

Know and Understand questions enable you to demonstrate knowledge, identification, and comprehension of chapter material. These review questions are provided both at the end of each section for immediate review of content and as a cumulative review at the end of each chapter.

Critical Thinking questions develop higher-order thinking and problem-solving, personal, and workplace skills.

Activities extend your learning and help you apply knowledge.


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Chapter Summary

- Wood is one of the few industrial raw materials that are renewable.
- Wood is biodegradable.
- Wood insulates six times better than brick or stone.
- Soil, water, and trees are three of our greatest natural resources.
- Reforestation is the process of replanting trees in an area that has been harvested.
- Most trees must grow for 20 or more years before they are ready for harvesting.
- Kiln drying of lumber is better than air drying because the rate of moisture is controlled.
- Manufactured wood panels are made from fibers, strands pieces, or particles of wood held together with adhesives.
- By-products of trees are used to produce medicines, cosmetics, dyes, inks, paper, and rayon.

Know and Understand

Answer the following questions based on the information provided in this section.

1. *True or False?* Newly wood cells are formed in the cambium layer near the bark.
2. *True or False?* The terms *hardwood* and *softwood* refer to the hardness or softness of the wood.
3. *True or False?* Wood with large cells form close-grained lumber.
4. Veneers may be cut using which of these methods?
   A. Rotary
   B. Flat
   C. Quarter
   D. All of the above.
5. *True or False?* Three types of plywood cores are veneer, solid lumber, and particleboard.
6. *True or False?* Waferboard and oriented strand board are examples of plastic lumber.
7. *True or False?* Most paper products are made from wood.
8. ____ is a fiber produced from cellulose.
   A. Plastic
   B. Rayon
   C. Nylon
   D. Cotton
9. It is best to store plywood ____.
   A. flat
   B. upright
   C. leaning
   D. None of the above.
10. *True or False?* Project wood selection should be based on price alone.

Critical Thinking

1. What are some of the various ways our society can preserve and protect our trees and environment?
2. Describe some modern methods of recycling various wood products.

Activities

1. Trace the growth cycle of trees using the internet and library resources. Why do redwood trees usually live longer than other trees?
2. Visit a local lumber yard to see how they store and care for wood.
3. Reforestation plays a major role in having plenty of trees available for future use. List things that you can do to support the conservation of our natural resources.

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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text



Exploring Woodworking provides the essential knowledge that beginning students require, introducing different woods and their characteristics in addition to basic techniques using hand and power tools.

Workbook

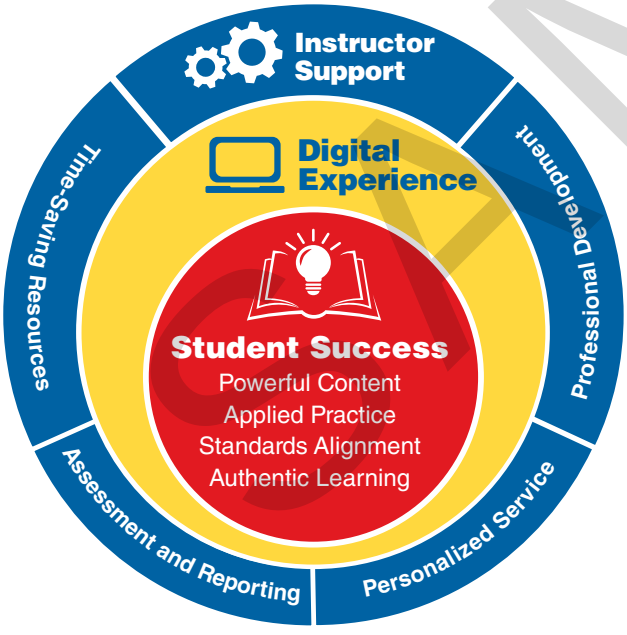
- Includes review questions to help students recall, review, and apply concepts introduced in the book.

G-W Companion Website

For digital users, e-flash cards and vocabulary exercises allow interaction with content to create opportunities to increase achievement.

Online Learning Suite

- Online student text and workbook, along with rich supplemental content, bring digital learning to the classroom.
- All instructional materials are accessible at home, at school, or on the go.



Instructor Tools

LMS Integration

Integrate Goodheart-Willcox content within your Learning Management System for a seamless user experience for both you and your students. EduHub LMS–ready content in Common Cartridge® format facilitates single sign-on integration and gives you control of student enrollment and data. With a Common Cartridge integration, you can access the LMS features and tools you are accustomed to using and G-W course resources in one convenient location—your LMS.

G-W Common Cartridge provides a complete learning package for you and your students. The included digital resources help your students remain engaged and learn effectively:

- **Digital Textbook**
- **Online Workbook content**
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When you incorporate G-W content into your courses via Common Cartridge, you have the flexibility to customize and structure the content to meet the educational needs of your students. You may also choose to add your own content to the course.

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- The **Instructor Resources** provide instructors with time-saving preparation tools such as answer keys, editable lesson plans, and other teaching aids.
- **Instructor's Presentations for PowerPoint®** are fully customizable, richly illustrated slides that help you teach and visually reinforce the key concepts from each chapter.
- Administer and manage assessments to meet your classroom needs using **Assessment Software with Question Banks**, which include hundreds of matching, completion, multiple choice, and short answer questions to assess student knowledge of the content in each chapter.

See www.g-w.com/exploring-woodworking-2024 for a list of all available resources.

Professional Development

- Expert content specialists
- Research-based pedagogy and instructional practices
- Options for virtual and in-person professional development

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