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Unit 1 Wood and Lumber

Unit Objectives

After completing this unit, the student should be able to:

- Name the parts of a tree trunk and state each part's function.
- Describe methods of cutting the log into lumber.
- Define hardwood and softwood, give examples of some common kinds, and list their characteristics.
- Explain moisture content at various stages of seasoning, tell how wood shrinks, and describe some common lumber defects.
- State the grades and sizes of lumber and compute board measure.

Key Terms

Chapter 1

Annular rings The rings seen when viewing a cross-section of a tree trunk; each ring constitutes one year of tree growth (p. 6)

Cambium layer A layer just inside the bark of a tree where new cells are formed (p. 5)

Close-grained Wood in which the pores are small and closely spaced (p. 6)

Coniferous Cone-bearing tree; also known as *evergreen* (p. 6)

Deciduous Trees that shed leaves each year (p. 6)

Hardwood The wood of broad-leafed deciduous trees (as distinguished from the wood of conifers) (pp. 6, 837)

Heartwood The wood in the inner part of a tree, usually darker, inactive cells (p. 5)

Lignin The natural glue in wood that holds together the wood cells and fibres (p. 5)

Medullary rays Bands of cells radiating from the cambium layer to the pith of a tree to transport nourishment toward the centre (p. 5)

Open-grained A texture quality of wood where wood cells or pores are open to the surface (p. 6)

Pith The small, soft core at the centre of a tree (p. 5)

Sapwood The outer part of a tree just beneath the bark containing active cells (p. 5)

Softwood Wood from coniferous (cone-bearing) trees (pp. 6, 837)

Chapter 2

Air-dried The term for lumber that has been seasoned by drying in the air (p. 14)

Battens Thin, narrow strips usually used to cover joints between vertical boards (p. 750)

Board foot A volume of wood that measures 1 foot (305 mm) square and 1 inch (25 mm) thick or any equivalent lumber volume (p. 19)

Boards Lumber usually 8 inches (203 mm) or more in width and less than 1½ inches (38 mm) thick (p. 17)

Bow A type of warp in which the side of lumber is curved from end to end (p. 16)

Checks Lengthwise splits in the end or surface of lumber, usually resulting from more rapid drying of the end than the rest of the piece (p. 16)

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Crook A type of warp in which the edge of lumber is not straight (p. 16)

Cup A type of warp in which the side of a board is curved from edge to edge (p. 16)

Dimension Lumber used for framing having a nominal 2 inch, actual 1½ inch (38 mm) (p. 17)

Dunnage Short lengths of lumber (or drywall) used to keep lumber or sheet goods off the floor or ground (pp. 16, 813)

Equilibrium moisture content The point at which the moisture content of wood is equal to the moisture content of the surrounding air (p. 14)

Fibre-saturation point The moisture content of wood when the cell cavities are empty but the cell walls are still saturated (p. 13)

Firsts and seconds (FAS) The best grade of hardwood lumber (p. 17)

Grade Identifies the quality of lumber; also, the level of the ground (p. 17)

Green lumber Lumber that has not been dried to a suitable moisture content (p. 12)

Greenhouse gas Gases emitted into the atmosphere that trap the radiant heat of the sun that is reflected off the Earth's surface (p. 20)

Juvenile wood The portion of wood that contains the first seven to fifteen growth rings of a log; located in the pith (p. 16)

Kiln-dried The term for lumber that has been dried by placing it in huge ovens called *kilns* (p. 14)

Knots Defects in lumber caused by cutting through a branch or limb embedded in the log (p. 16)

Lumber Wood that is cut from the log to form boards, planks, and timbers (p. 10)

Lumber grades Numbers and letters used to rank wood according to quality (p. 17)

Moisture content (MC) The amount of moisture in wood expressed as a percentage of the dry weight (p. 13)

Moisture meter A device used to determine the moisture content of wood (p. 14)

No. 1 common A lower grade of hardwood lumber (p. 17)

Nominal size The stated size of the thickness and width of lumber, even though it differs from its actual size; the approximate size of rough lumber before it is surfaced (p. 19)

Pecky Wood that has small grooves or channels running with the grain (p. 16)

Pitch pockets Openings in lumber between annular rings containing pitch in either liquid or solid form (p. 16)

Plain-sawn A method of sawing lumber that produces flat grain (p. 11)

Quarter-sawn A method of sawing lumber parallel to the medullary rays to produce edge-grain lumber; see *edge grain* (p. 12)

Sawyer A person whose job is to cut logs into lumber (p. 12)

Seasoned The term for lumber that has been dried to a suitable moisture content (p. 13)

Shake A defect in lumber caused by a separation of the annular rings (p. 16)

Timbers Large pieces of lumber over 5 inches (127 mm) in thickness and width (p. 17)

Twist Lumber defect in wood (p. 16)

Wane Bark, or lack of wood, on the edge of lumber (p. 16)

Warp Any deviation from straightness in a piece of lumber (p. 16)

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Chapter 1 Wood



Slides 1-2 to 1-9

A. Wood

1. Wood has properties that make it the first choice in many applications in home construction.
2. Wood is easy to tool and work with, is pleasing to look at and smell, and has strength that will last a long time.
3. Lumber is manufactured from the renewable resources of the forest.
   - It is necessary to understand the nature of wood to get the best results from the use of it.
   - With this knowledge, the carpenter is able to protect lumber from decay, select it for appropriate use, work it with proper tools, and join and fasten it to the best advantage.
4. The carpenter works with wood more than any other material and must understand its characteristics in order to use it intelligently.
   - It can be more easily cut, shaped, or bent into almost any form than just about any other structural material.
   - It is an efficient insulating material.
5. Wood resists the flow of heat energy six times better than brick and 14 times better than concrete of equal thickness.
6. There are many kinds of wood that vary in strength, workability, elasticity, colour, grain, texture, and smell.
   - For instance, baseball bats, diving boards, and tool handles are made from hickory and ash because of their greater ability to bend without breaking (elasticity).
   - Oak and maple are used for floors because of their beauty, hardness, and durability.
   - Redwood, cedar, cypress, and teak are used in exterior situations because of their resistance to decay.
   - Cherry, mahogany, and walnut are typically chosen for their beauty.
7. With proper care, wood will last indefinitely.
   - Wood is one of our greatest natural resources.
   - With wise conservation practices, wood will always be in abundant supply.
   - When those structures have served their purpose and are torn down, the wood used in their construction can be salvaged and used again (recycled) in new building, remodelling, or repair.
   - Wood is biodegradable, and when it is considered not feasible for reuse it is readily absorbed back into the earth with no environmental harm.

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PPT Slides 1-10 to 1-16	**B. Structure and Growth** 1. Wood comes from trees made up of different kinds of cells, which are held together by a natural adhesive substance called **lignin**. 2. Tree growth takes place in the **cambium layer**, which is just inside the exterior protective bark layer. The cambium layer produces both outer bark cells and inner wood cells. 3. Water passes from the roots upward through the **sapwood** to the leaves where it combines with carbon dioxide and sunlight, converting the water into food. 4. The food product is carried down and distributed toward the centre through the **medullary (horizontal) rays**. 5. The centre of the tree is called the **pith**, a soft spongy portion of the tree trunk. 6. The **heartwood** is darker in the coloured portion of the trunk. The heartwood portion of the trunk is the inactive "backbone" of the tree. 7. The **annular rings** are made up of two portions: the lighter early-growth and the darker late-growth portion. It is this difference in colour that makes each ring identifiable. The early growth is less dense than the late growth of each ring. The annular rings and the sawing method used will define the grain patterns and characteristics of the lumber. • The rings vary in width each year, identifying the "quality" of the growing season. A cross-section of a tree's trunk is like a snapshot of the tree's life. Good years and bad years are shown. Counting annular rings reveals a tree's age.
PPT Slides 1-17 to 1-23	**C. Hardwoods and Softwoods** 1. Deciduous trees are known as hardwoods; they shed their leaves each year. • Common hardwoods include ash, birch, cherry, hickory, maple, mahogany, oak, and walnut. 2. Coniferous trees are known as softwoods; these are cone-bearing trees, commonly known as evergreens. • Common softwoods include pine, fir, hemlock, spruce, cedar, cypress, and redwood. 3. Wood can also be divided into two groups according to cell structure. • Open-grained wood has large cells, indicated by the medullary rays that look like tiny openings or pores in the surface; such woods include oak, ash, hickory, mahogany, and walnut. • All softwoods are close-grained and include all of the softwoods as well as many hardwood species such as birch, cherry, maple, and poplar, to name a few.

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***Teaching Tip**	*Have your students open their textbooks to pages 8 and 9 and initiate a discussion about the different types of wood. Bring a bunch of samples with you and pass them around to see whether students can identify them. Make a game of it: use the chart and samples to engage students in the learning process.* *Students will be able to see, touch, and smell each species. These samples should be raw and freshly sanded or jointed to have the aroma of each species present. If you can, provide a flat- and edge-sawn sample for each species of softwood and a plain- and quarter-sawn sample of each species of hardwood.*

Softwoods

Kind	Colour	Grain	Hardness	Strength	Work-ability	Elasticity	Decay Resistance	Uses	Other
Red Cedar	Dark Reddish Brown	Close Medium	Soft	Low	Easy	Poor	Very High	Exterior	Cedar Odour
Fir	Yellow to Orange Brown	Close Coarse	Medium to Hard	High	Hard	Medium	Medium	Framing Millwork Plywood	
Ponderosa Pine	White with Brown Grain	Close Coarse	Medium	Medium	Medium	Poor	Low	Millwork Trim	Pine Odour
Sugar Pine	Creamy White	Close Fine	Soft	Low	Easy	Poor	Low	Pattern-making Millwork	Large Clear Pieces
Western White Pine	Brownish White	Close Medium	Soft to Medium	Low	Medium	Poor	Low	Millwork Trim	
Southern Yellow Pine	Yellow Brown	Close Coarse	Soft to Hard	High	Hard	Medium	Medium	Framing Plywood	Much Pitch
Redwood	Reddish Brown	Close Medium	Soft	Low	Easy	Poor	Very High	Exterior	Light Sapwood
Spruce	Cream to Tan	Close Medium	Medium	Medium	Medium	Poor	Low	Siding Subflooring	Spruce Odour
Tamarack	Yellow Brown	Close Medium	Soft to Hard	High	Hard	Medium	High	Finishing Flooring	Fence Posts

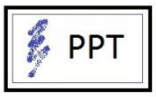
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Hardwoods									
Kind	**Colour**	**Grain**	**Hardness**	**Strength**	**Work-ability**	**Elasticity**	**Decay Resistance**	**Uses**	**Other**
Ash	Light Tan	Open Coarse	Hard	High	Hard	Very High	Low	Tool Handles Oars Baseball Bats	
Basswood	Creamy White	Close Fine	Soft	Low	Easy	Low	Low	Drawing Bds. Veneer Core	Imparts No Taste or Odour
Beech	Light Brown	Close Medium	Hard	High	Medium	Medium	Low	Food Containers Furniture	
Birch	Light Brown	Close Fine	Hard	High	Medium	Medium	Low	Furniture Veneers	
Cherry	Lt. Reddish Brown	Close Fine	Medium	High	Medium	High	Medium	Furniture	
Hickory	Light Tan	Open Medium	Hard	High	Hard	Very High	Low	Tool Handles	
Lauan	Lt. Reddish Brown	Open Medium	Soft	Low	Easy	Low	Low	Veneers Underlayment Panelling	
Mahogany	Russet Brown	Open Fine	Medium	Medium	Excellent	Medium	High	Quality Furniture	
Maple	Light Tan	Close Medium	Hard	High	Hard	Medium	Low	Furniture Flooring	
Oak	Light Brown	Open Coarse	Hard	High	Hard	Very High	Medium	Flooring Boats	
Poplar	Greenish Yellow	Close Fine	Medium Soft	Medium Low	Easy	Low	Low	Furniture Underlayment Veneer Core	
Teak	Honey	Open Medium	Medium	High	Excellent	High	Very High	Furniture Boat Trim	Heavy Oily
Walnut	Dark Brown	Open Fine	Medium	High	Excellent	High	High	High-Quality Furniture	

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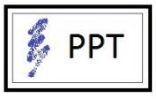
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 Slides 1-24 and 1-25	**D. Identification of Wood** 1. Identifying different kinds of wood can be very difficult, because some closely resemble each other. • For instance, ash and white oak are hard to distinguish from each other, as are some pine, hemlock, and spruce. • Not only are they the same colour, but the grain pattern and weight are about the same. • Only the most experienced workers are able to tell the difference. 2. It is possible to get some clues to identifying wood by studying the literature, but the best way to learn the different kinds of wood is by working with them. • Look at the colour and the grain; feel if it is heavy or light, if it is soft or hard; and smell it for a characteristic odour. • Cedar can always be identified by its pleasing, moth-repelling odour.
 Slide 1-26	**Conclusions** Understanding the parts of a tree is important. Carpenters are called upon to construct a wide variety of wood structures, floors, cabinets, and other interior sections of houses and buildings. Knowing which type of wood should be used for various tasks helps ensure quality work. Practice and experience will lead to the ability to identify wood types.

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Chapter 2 Lumber

 Slides 2-2 to 2-8	**A. Manufacture of Lumber** 1. Bark is removed from logs. 2. Logs are sliced into large planks. 3. The large planks are sliced, edged, and trimmed into various dimensions to create lumber. 4. Lumber is stacked and banded outdoors to air-dry. The lumber is spaced with small maple or synthetic stickers to allow for air circulation throughout the entire stack. 5. After air-drying the stack for several weeks or months, the lumber is moved into a drying kiln.
***Teaching Tip**	*Passing around four or five hardwood and softwood species that are commonly used in your area will help students to identify with the products. Students will be able to see, touch, and smell each species. These samples should be raw and freshly sanded or jointed to have the aroma of each species present. If you can, provide a flat- and edge-sawn sample for each species of softwood, and a plain- and quarter-sawn sample of each species of hardwood. A field trip to a local sawmill will be of great value.*
 Slide 2-9	**B. Plain-Sawn Lumber** 1. Common way of cutting lumber. 2. The log is cut tangent to the annular rings. • Produces commonly identifiable cathedral grain pattern on the lumber face. • Less expensive way of cutting. • Produces greater widths. • Produces a less stable lumber product. • Wide boards will cup as the annular rings straighten.
 Slide 2-10	**C. Quarter-Sawn Lumber** 1. Produces pieces in which annular rings are at or almost at right angles to the wide surface. • Produces a more stable lumber product that will not cup because of the very short vertical annular rings. • Durable due to the wear on the edge of the annular rings. • Also called vertical-grain or edge-grain.
 Slide 2-11	**D. Combination Sawing** 1. Use of both plain-sawing and quarter-sawing. • The sawyer determines the best cut to minimize waste and reduce time to get the desired amount and kinds of lumber.

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PPT Slides 2-12 and 2-13	**E. Moisture Content and Shrinkage** 1. Lumber when first cut from the log is called green lumber. • Green lumber contains a great amount of water. • Green lumber should not be used in construction. • Using green lumber can result in many construction defects due to shrinking and warping as it reaches the moisture equilibrium of the surrounding air. 2. Green lumber is subject to decay, sometimes called dry rot, which is caused by fungi. • To prevent excessive shrinkage, dry rot, and general decay, the wood moisture must not exceed 19 percent. • Seasoned lumber should be stored in such a way as to prevent decay and rot.
***Teaching Tip**	*Good housekeeping practices on site will produce a safer work environment and help to reduce lumber warping. Coating the ends of lumber while air-drying will help to reduce splitting and checking at the lumber ends.*
PPT Slides 2-14 to 2-16	**F. Moisture Content** 1. Expressed as a percentage; indicates how much wood weight is actually water. 2. Determined by the difference in the weight of wood before and after it has been oven-dried; that number is divided by the dry weight. • A piece of wood weighs 16 ounces wet and 13 ounces dried. • The wet weight of 16 ounces minus the dry weight of 13 ounces equals 3 ounces. • The difference of 3 ounces divided by the dry weight of 13 ounces equals 0.2307. • Then, 0.237 times 100 equals 23 percent. • The water weight of the piece of wood before drying was 23 percent. 3. Softwood lumber used for framing and rough carpentry should not have a moisture content that exceeds 19 percent. • Lumber used for interior finishes should not have a moisture content that exceeds 8 percent. 4. Wood has reached the fibre-saturation point when all of the free water in the cells has been removed; no noticeable shrinkage or warping takes place up to this point. • As the water in the cell walls is removed, the wood starts to shrink and warp. • Equilibrium moisture content is reached when the moisture content reaches that of the surrounding air (about 10 to 12 percent). As a rule of thumb, it takes about one year for every inch of stock thickness to air-dry down to 10 to 12 percent.

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- Almost no shrinkage occurs along the length of lumber; most shrinkage occurs across the face of the lumber and then the width. The lumber shrinkage is relative to the shrinkage of each wood cell and its neighbouring wood cells. Therefore, a 4 × 4 will shrink roughly the same across its faces; however, a 2 × 4 will shrink roughly twice as much across the face of the stock in relation to the thickness.

Lumber Size	Actual Width	Width @ 19% MC	Width @ 11% MC	Width @ 8% MC
2 × 4	3½" (89 mm)	3½" (89 mm)	3 7/16" (87 mm)	3⅜" (86 mm)
2 × 6	5½" (140 mm)	5½" (140 mm)	5⅜" (137 mm)	5 5/16" (135 mm)
2 × 8	7¼" (184 mm)	7¼" (184 mm)	7⅛" (181 mm)	7 1/16" (179 mm)
2 × 10	9¼" (235 mm)	9¼" (235 mm)	9 1/16" (230 mm)	9" (228 mm)

Teaching Tip

Have a moisture meter on hand. Use three or four pieces of lumber at various stages of seasoning to show students how to use the meter. Keep the greenest piece of lumber in the classroom for a couple of weeks. Revisit it with the moisture meter. Have the class note the shrinkage and warping that is associated with the loss of moisture.

PPT

Slides 2-17 and 2-18

G. Drying Lumber

1. Lumber is either air-dried, kiln-dried, or a combination of both.
2. Wood stacked in piles with spacers or stickers is air-drying.
   - Once the lumber has had a chance to air-dry for a while, it is then moved into in large "ovens" or kilns and is kiln-dried.
   - Kiln-drying takes less time, and is more expensive than air-drying. Kiln-drying is the only way to remove more moisture than the moisture equilibrium of the surrounding air.
3. Recommended moisture content for exterior-finish lumber is 12 percent, except in very dry climates.
   - Lower moisture content is used for interior trim and cabinets.
   - A moisture meter is used to determine moisture content.
4. Hardwood and softwood lumber is used for cabinet, furniture, and millwork that is sold in its rough state, requiring the carpenter to "dress" the lumber to the desired width and thickness, as well as smooth all four sides.
5. Construction (SPF) lumber is surfaced on four sides ready to be used.

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***Teaching Tip**	*If available, various warp types should be shown to students. Compare the cost of rough stock to dressed stock. This will reinforce the necessity for learning the basic skills required for dressing lumber.*
 Slide 2-19	**H. Lumber Storage** 1. Proper management and good housekeeping of a construction site is imperative for safety and for cost-effective building. 2. Lumber should be delivered so that the materials are available in the order of use. 3. Lumber stored on the jobsite should be protected from moisture and other hazards. 4. Never place lumber directly on the ground. 5. Lumber should be neatly stacked and kept in good order to prevent twisting and warpage.
***Teaching Tip**	*Construction-grade lumber will have a manufacturer's stamp. This stamp will indicate the moisture content, mill number, lumber grade, and certifying body that allows the mill to produce lumber products. Have students take note of a lumber stamp and identify the stamped components.*
 Slides 2-20 and 2-21	**I. Lumber Defects** 1. Lumber warps include crowning, cupping, twisting, and bowing. 2. Checks are caused when the ends dry faster than the rest of the stock; checking at the end of the stock can be minimized by sealing the ends of the stock with paint, lacquer, or wax. 3. Cracks running parallel to and between the annular rings are called shakes; they are caused by weather or damage to the tree. Shake can be seen in standing trees and logs by noticing an oval shape to the trunk or log. 4. The pith is the spongy centre of the tree. 5. Juvenile wood contains the first 7 to 15 growth rings. 6. Knots are cross-sections of branches in the trunk. 7. Pitch pockets are small cavities that hold pitch, which sometimes oozes out. 8. A wane is the presence of exterior bark at the edge of the stock or a missing corner of the stock. 9. Pecky wood has small grooves or channels running with the grain. 10. Other defects are stains, decay, and wormholes.
***Teaching Tip**	*Pictures of the warps and defects are a must. If you have samples to pass around, that would be an asset. Revisit the lumber stamp discussion and introduce the national and international wood products associations that govern the industry at large.*

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PPT Slide 2-22	**J. Lumber Grades and Sizes** 1. Established by wood products associations. 2. Grade stamps indicate that strict quality control and the lumber grade standards have been met. • The grade stamp on lumber indicates the mill number, lumber grade, species, and whether the wood was green or dry when planed.
***Teaching Tip**	*Show examples of nominal versus actual sizes.*
PPT Slide 2-23	**K. Softwood Grades** 1. Western Wood Products Association (WWPA) grades lumber in three categories: board, dimension, and timber. • Board group—under 2 inches (51 mm), divided into boards, sheathing, and form lumber. • Dimension group—2 to 4 inches (51 to 102 mm), divided into light framing, studs, structural light framing, rough carpentry, structural joists, truss manufacturing, and planks. • Timber group—5 inches (127 mm) and thicker, divided into beams and stringers. 2. The three main categories are further classified by strength and appearance.
PPT Slide 2-24	**L. Hardwood Grades** 1. Established by the National Hardwood Lumber Association. o Best grade is called firsts and seconds (FAS); it is 6 inches (150 mm) wide and 8 feet (2440 mm) long. o Next best grade is select; minimum width is 4 inches (100 mm) minimum length is 6 feet (1630 mm). 2. No. 1 common allows even narrower widths and shorter lengths.
***Teaching Tip**	*Take some time here to explain the concept of board feet and how to calculate board feet. Explain that rough lumber and lumber products are sold on the global market in board feet, similar to crude oil sold by the barrel. Point out that we pay for the volume of lumber sawn from the log, not what we receive over the counter.*
PPT Slide 2-25	**M. Lumber Sizes** 1. Rough lumber from the sawmill is nominal size; a 2 × 4 is close to measuring 2 inches (51 mm) thick by 4 inches (100 mm) in width. • Surface dressed wood is actually smaller than what it is called; the 2 × 4 would measure 1½ inches (38 mm) thick by 3½ inches (89 mm) in width. • Hardwood is usually purchased in rough lumber, and then dressed to required sizes as needed.

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PPT Slides 2-26 to 2-30	**N. Board Measure** 1. Framing or rough carpentry lumber is usually purchased by specifying number of pieces—thickness″ × width″ × length′. • Lumber may also be purchased by linear feet or board feet. • Hardwood lumber is purchased by specifying grade, thickness, and total number of board feet. 2. A board foot is a measure of lumber volume; a piece of wood that measures 1 inch thick, 1 foot wide, and 1 foot long is one board foot. 3. Two ways to typically calculate board feet: a. Thickness in inches × Width in inches × Length in inches / 144 b. Thickness in inches × Width in inches × Length in feet / 12 Both calculations will give the same answer.
PPT Slides 2-31 to 2-34	**O. A Green Industry** 1. Greenhouse gas (GHG) emissions are released into the atmosphere by human activity (reported in megatonnes of CO_2 equivalent). GHG emissions are a global problem. 2. The sins of clear cutting are in the past and the industry is moving forward with definitive plans for the future. Forests are treated as a garden, with the proper spacing of plants, thinning or weeding to reduce overgrowth, and management of parasites. 3. Operational standards have been set by three organizations within Canada: • Canadian Standards Association (CSA) • Sustainable Forestry Initiative (SFI) ▪ both under the umbrella of the Programme for the Endorsement of Forest Certification (PEFC) schemes • Forest Stewardship Council (FSC) 4. Wood structures are strong, durable, and resilient enough to withstand earthquakes and high winds. Wood materials are renewable, recyclable, biodegradable, and they store carbon. Trees take in CO_2 and release oxygen (O_2) into the atmosphere. Building with wood is good for the occupants, for the environment, and for Canada and the world.
PPT Slide 2-35	**Conclusions** Lumber can be air-dried or kiln-dried; both reduce shrinkage and allow for acceptable moisture content levels. Green wood should never be used in construction. Grading lumber provides quality control in the lumber industry. Lumber can be ordered by pieces, linear feet, or board feet.

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Answers to Review Questions

Unit 1

1. c	2. d	3. a	4. c	5. c
6. b	7. a	8. b	9. b	10. c

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UNIT 1 WOOD AND LUMBER

Chapter 1 Wood

Multiple Choice

1. D; 2. B; 3. D; 4. C; 5. D; 6. B; 7. A; 8. C; 9. A; 10. D

Completion

1. Deciduous
2. coniferous
3. sapwood
4. hardwood
5. softwood
6. open
7. heartwood
8. cells
9. odour
10. working

Identification

1. C; 2. A; 3. D; 4. E; 5. F; 6. B; 7. G

Math Problem Solving

1. 157; 2. 131; 3. 26; 4. 1683; 5. 6′-6″ (197 cm); 6. 5′-3″ (160.5 cm)

Chapter 2 Lumber

Multiple Choice

1. C; 2. A; 3. D; 4. B; 5. A; 6. C; 7. B; 8. B; 9. B; 10. A

Completion

1. Plain
2. Quarter
3. sawyer
4. green
5. moisture
6. fungi
7. 20
8. 19
9. 12
10. Equilibrium
11. 4
12. warps

Identification

1. B; 2. G; 3. D; 4. E; 5. F; 6. C; 7. A

Math Problem Solving

1. 1750; 2. 15; 3. 24; 4. 20 000; 5. 100

Discussion

1. The process of air drying lumber is less expensive than kiln drying to perform. Kiln drying lumber is much faster than air drying.

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