



WOOD: A SCIENTIFIC WONDER

Middle School Lesson – Branching Out

WOOD: A SCIENTIFIC WONDER

Branching Out

Developed By: Gina Smith, LEAF – Wisconsin’s K-12 Forestry Education Program

Target Grade Level: 6-8

Appropriate for 9-12

Appropriate for 4-5 if educators provide reading support/modifications

Suggested resources for K-4 included

Science Categories

Forestry, Properties of Wood, Wood Products, Mass Timber, Sustainability

Time Frame: ~2 hrs; 2-3 class periods

- **Introduction & Activity 1:** 30-45 minutes
- **Activity 2:** 30-45 minutes
- **Conclusion:** 30-45 minutes

Materials

- *Wood: A Scientific Wonder* video
 - At a minimum start with the segment in the fire lab where they look at char rate and watch the CARWASH, Wood Protection Lab and Engineering Mechanics and Remote Sensing Lab segments.
- Student Sheet: *Branching Out - Wood Database Research* – Activity 1
- Student Sheet: *Branching Out - Building for the Future* – Activity 2
- The Wood Database, Wood Filter (online tool) https://www.wood-database.com/wood-filter/?fwp_janka=67.00%2C4630.00 (You can also search for it using key words Wood Database, Wood Filter)
- World’s tallest timber building opens from Inside the Forest Service. <https://www.fs.usda.gov/inside-fs/delivering-mission/apply/worlds-tallest-timber-building-opens> (If this link doesn’t work, you can find similar articles by searching “Ascent MKE Building”).
- Fact Sheet – *Building Sustainably: Mass Timber* (September 2023): https://www.eesi.org/files/FactSheet_Mass_Timber_2023.pdf
 - This resource can also be accessed from the Environmental and Energy Study



Institute White Papers – Fact Sheets and Issue Briefs website <https://www.eesi.org/papers> or by searching Building Sustainably Mass Timber Fact Sheet.

- Print pdf versions of the fact sheet for students to use or provide students with online access to the fact sheet.
- Optional: Into the Outdoors episode *Timber Structures* or Classroom video *Understanding Timber Structures: From Research to Reality*

Key Words

- coarse grain, crushing strength, density, distribution, elastic modulus, end grain, fine grain, grain or texture, heartwood, Janka hardness, module of rupture, rot resistance, sapwood, specific gravity, shrinkage, sustainability, toxicity, warping, workability, CITES Agreement/ Appendices, IUCN Red List

Learning Objectives

Students will be able to:

- Identify characteristics and properties of common woods.
- Examine the properties of wood influence its use.
- Explore current and future uses of wood as a building material.

Activity Summary

After viewing the segments from the Into the Outdoors episode, *Wood: A Scientific Wonder*, students will use the Wood Database – Wood Filter to explore the properties of hardwoods and softwoods. Students will examine how the properties of wood influence its use – specifically as a building material. Students will read about innovations in mass timber and learn how it can be used in sustainable construction. The concluding activity provides students with the opportunity to come up with a creative way to use mass timber in the design of a single-family home that both improves the design of the home and makes the construction of single-family homes more sustainable.

Vocabulary

Coarse grain: Wood with open growth rings with uneven texture – a more irregular look.

Crushing strength: Maximum amount of compression (squeezing) wood can take before it fractures/ breaks.

Density: Relationship between the mass of the wood and how much space it takes up (how close together atoms/particles are); Density can be calculated by dividing mass by volume.

Distribution: Where trees grow throughout the world.

Elastic modulus: Measure of the wood's stiffness; how strong it is; Ability of wood to stretch without getting permanently losing its shape (getting stretched out); range is 800,000-2,500,000 psi.

End grain: The grain of wood seen when it is cut perpendicular to (across) its growth rings.

Fine grain: Wood with tighter growth rings with even texture – a more even look.

Grain or Texture: The arrangements of wood fibers seen on a cut surface of wood.



Heartwood: Dense inner part of a tree trunk; hardest timber comes from heartwood.

Janka hardness: Measures the resistance of wood to denting and wear; range is 0 to 4,000; wood with a ranking near 4,000 is so hard it is difficult to saw.

Module of rupture: Material's maximum load carrying capacity when bent; range is 5,000-15,000 psi.

Rot resistance: Ability of wood to resist moisture and decay; woods with natural oils and dense fibers are usually more rot resistant.

Sapwood: Soft, outer layers between the heartwood and the bark of the tree.

Specific gravity: Ratio of the density of the wood compared to the density of water; a specific gravity less than 1 will float on water a specific gravity greater than 1 will sink in water.

Shrinkage: How much the wood will decrease in size (contract/shrink) when it dries.

Sustainability: Is the wood able to be used now and in the future or are there risks to using the wood?

Toxicity: Poisonous or able to cause harm.

Warping: When wood is bent out of shape; usually due to wetness or heat.

Workability: How easy the wood is to use with hand or machine tools.

CITES Agreement/Appendices: The Convention on International Trade in Endangered Species of Wild Fauna and Flora is an agreement between governments to help make sure trade does not threaten the survival of any species.

IUCN Red List: List of threatened species produced by the International Union for Conservation of Nature and Natural Resources.

Background Information

How trees grow: Trees grow up and out, getting both taller and wider. Trees grow by absorbing water and nutrients from the soil through their roots. Water and nutrients are carried up through the **sapwood (xylem)** to the leaves where they are combined with carbon dioxide and sunlight to make food (through photosynthesis). The food is carried by the **inner bark (phloem)** to the growing parts of the tree. The growing parts of the tree are the **buds, cambium** and **root tips**. Both the xylem and phloem are located in the cambium.

Each year **buds** produce new twigs. As the twigs grow, tree branches get longer. This causes the tree to grow taller and the crown of the tree to grow wider. As this happens, the **root tips** all grow and get longer. This helps the tree absorb more water and nutrients. The longer roots also help anchor and support the tree. The cambium is responsible for horizontal growth – the tree getting wider (increasing diameter). Growth in the cambium adds layers to the bark wall and to the inside wood.

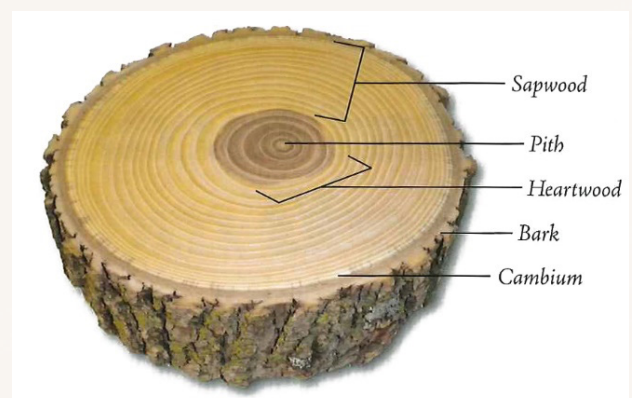


Image used with permission from
Wood: Identifying and Using Hundreds of Woods Worldwide
Eric Meier (2016)



The type of tree, how it grows, and time of year all impact the cell structure of the tree. Most tree growth takes place in the early spring. When trees grow fast (spring) their cells are more stretched and less dense. When trees grow slower at other times of year, the cells are denser which makes the wood look darker. The difference between fast and slow growth each year makes annual growth rings in trees. Fast-growing, short-lived tree species produce trunks with less wood and more open space in their cells. Slow-growing, long-lived tree species produce trunks with more wood and fewer open spaces in their cells making them stronger.

Background information on wood anatomy and other characteristics of wood, can be accessed using the following resources:

- The Wood Database – Hardwood Anatomy, Eric Meier. <https://www.wood-database.com/wood-articles/hardwood-anatomy/>
- The Wood Database – Softwood Anatomy, Eric Meier. <https://www.wood-database.com/wood-articles/softwood-anatomy/>
- The Wood Database – Wood Filter, Eric Meier. <https://www.wood-database.com/wood-filter/>
- Wood Handbook – Wood as an Engineering Material, Chapter 2 *Characteristics and Availability of Commercially Important Woods*, Michael C. Weimann, Ma

Learning Procedure

Introduction: Segment from *Wood: A Scientific Wonder*

If you have ample time, show the full video, *Wood: A Scientific Wonder*. If you are pressed for time, at a minimum start with the segment in the fire lab where they look at char rate and watch the CARWASH, Wood Protection Lab and Engineering Mechanics and Remote Sensing Lab segments.

- Ask students to share what they learned from these segments and why it is important to know/research this information about wood and wood products.





Activity 1: The Wood Database – Wood Filter

Tell students they are going to use a tool called The Wood Database – Wood Filter to learn about different types of wood that are common in the United States. Tell them that the Wood Database was created by a woodworker to provide people with easy to access information about wood. The information included in the wood database includes information on the anatomy of wood and the characteristics/properties of it – which is similar to some of the information found in the Wood Anatomy Collection at the Forest Products Lab. Tell students that they are going to use the wood database to become an expert on one species of hardwood and one species of softwood. Explain that after they learn about both their wood species, they will share what they have learned while playing a game with their classmates.

Before you begin, tell students that how trees grow helps determine the anatomy and properties of the wood it becomes. Discuss the basics about tree growth with students:

- Trees grow both up and out.
- Tree roots absorb nutrients and water from the soil. Leaves absorb carbon dioxide from the air. During **photosynthesis**, sunlight is used to transform the water absorbed by the roots and carbon dioxide absorbed by the leaves into food that is used to help the tree grow.
- Trees grow in these three ways:
 - **Buds** – Produce new twigs that help the tree grow taller and branch out to make a larger crown.
 - **Root tips** – Grow longer which helps the tree absorb more water and nutrients; roots also help anchor and support the tree.
 - **Cambium** – Is responsible for horizontal growth – the tree increasing in diameter; cambium growth adds layers to the bark wall and to the inside wood.
- Trees grow faster in spring than during other times of year.
 - When trees grow fast, their cells are more stretched out and less dense.
 - When trees grow slower, their cells are denser – this makes the wood look darker.
 - The difference between fast and slow growth in a year makes annual growth rings.
- Fast growing, short-lived tree species have trunks with less wood and more open spaces.
- Slow growing, long-lived tree species have trunks with more wood and fewer open spaces.

Pass out a copy of the Activity 1 sheet, *Wood Database Research*, to each student. Open up the Wood Database-Wood Filter so you can demonstrate to students how it works. <https://www.wood-database.com/wood-filter/> Select the first wood sample (with no filters) to use as an example (Abura, bahia). As you guide students through the information on Abura, focus on the properties of wood that are included in the vocabulary list and make sure students understand what each property is. Point out where students should record each property in the table on their student sheet. Tell students that the final row of the table is one of the most important – it is where students need to think about the



properties of the wood and how they relate to the use of the wood. Go over the instructions from the student sheet:

1. Access the Wood Database – Wood Filter using this link: <https://www.wood-database.com/wood-filter/>.
2. Check *North America* under **location** and *Only display common US woods* under **Filter out obscure species**. There should be 81 species of wood remaining in the database.
3. Check *Hardwood* under **Wood Type**. Select one hardwood from the database to research. Record information about it in the table below.
4. Once you have finished learning about a hardwood species, go back and select *Softwood* under **Wood Type**. Select one softwood from the database to research. Record information about it in the table below. Compare and contrast your hardwood and softwood samples.

Allow students ample time to complete their research and compare and contrast their hardwood sample to their softwood sample. When students have wrapped up their work, have them share what they have learned with each other using the stand-up, hand-up, pair-up protocol.

Stand-up, hand-up, pair-up:

1. Have students stand up with their activity sheet.
2. Tell students to walk around with their hand-up until they find someone who researched a different hardwood than they researched. When they find a person to share with, they should pair up.
3. Once all students are paired up, tell them that they need to share which hardwood they learned about and how its properties are related to its use. The student with a birth date closest to the start of the year (Jan 1) should share first.
4. Repeat the process a second time for hardwoods then switch to sharing about softwoods and complete the process twice. Each time students share, come up with a different way to determine who goes first (first name that starts closest to the end of the alphabet, wearing the most green, shortest last name, longest last name, etc.).

Transition to Activity 2

Lead students in a class discussion about the wood samples they studied. Ask students if any of the woods they researched are used in construction. (*Yes, let them share which woods.*) Ask them to provide examples of how the woods are used in construction. (*Flooring, plywood, closets, veneer, construction lumber, cabinets, trim*). Point out that many of these wood products are used in all types of buildings for cabinets, closets, trim, flooring, veneer, etc. Also share that construction lumber for framing, roofing, subfloors, etc. is not frequently used in large buildings, and high-rise buildings. Ask students what materials are used instead of lumber for large-scale building construction (*steel, cement*). Ask students if they think the woods they learned about in the database could be used to



replace materials like steel and concrete in the construction of large buildings. (*Wood products can be used to construct larger buildings – but not in the ways we have traditionally used them – as frames for buildings.*) Tell students that the forest products industry is finding ways to use wood to build large buildings and that the Forest Products Laboratory supports this work by testing new products and working to show how the products meet the standards required of building materials (remind students about the char segment from the *Wood: A Scientific Wonder* episode).

Activity 2: The Future of Wood as a Building Material

Tell students that wood has been the most common material used to build frames for homes throughout Wisconsin’s history but that the lumber used today is not quite as strong as lumber harvested from the original old growth forests of the past. Inform students red pine is most often used for framing homes. White pine and hardwoods like oak, maple, birch, walnut and cherry are often used for walls, cabinets and furniture.

Tell students that wood has not been used as a frame for most large, several story buildings since steel and concrete became more available in the early to mid-1900s. Buildings made from steel and concrete could be larger and taller than those made from wood. The buildings were also more fire resistant.

Share with students that the development of **mass timber** and other engineered wood products is changing the way people think about designing large buildings. Explain that mass timber products are wood products that are made by taking smaller wood pieces (lumber, veneers, fibers) and connecting them together (with adhesives, screws, dowels) to create large building components like columns, beams, rafters, floors and more. Tell students that the Forest Products Laboratory tests and researches timber structures to make sure they are strong and safe to use in the construction of large buildings. If time permits, show students the Into the Outdoors Episode *Timber Structures* or the Into the Outdoors Classroom episode *Understanding Timber Structures: From Research to Reality*.

As a class, read the article, *World’s tallest timber building opens* from Inside the Forest Service. <https://www.fs.usda.gov/inside-fs/delivering-mission/apply/worlds-tallest-timber-building-opens> (If this link doesn’t work, you can find similar articles by searching “Ascent MKE Building”). Guide students in taking notes on their Activity 2 Student Sheet – Building for the Future. Students should be listening for the following:

- How wood is being used to construct mass timber buildings
- Types of wood being used to construct mass timber buildings
- How using mass timber in construction is sustainable
- Benefits of building with mass timber



Pass out copies of Fact Sheet – *Building Sustainably: Mass Timber* (September 2023) printed from this link: https://www.eesi.org/files/FactSheet_Mass_Timber_2023.pdf (or allow students to access the fact sheet online). Have students read the fact sheet with a partner and record additional notes on their Activity 2 Student Sheet.

Discuss additional information they learned related to the four topics on their student sheet:

- How wood is being used to construct mass timber buildings
- Types of wood being used to construct mass timber buildings
- How using mass timber in construction is sustainable
- Benefits of building with mass timber

Conclusion: Mass Timber Design Project

Tell students that while the use of mass timber is catching on for large scale buildings in the United States, it isn't as frequently used in homes in the United States like it is in other countries in Europe. Tell students their job is to research the use of mass timber and/or cross-laminated timber in single family homes and create an item (design, ad, poster, sample webpage, video clip, social media post, etc.) to promote the use of mass timber components for building sustainable single-family homes. Students should consider costs and some of the concerns of using mass timber in single-family homes as they develop their idea.

If you prefer to share resources for students to use in their research ahead of time, consider these:

- Cross Laminated Timber (CLT) in Home Building <https://www.buildwithrise.com/stories/cross-laminated-timber-clt>
- 4 Reasons Single-Family Homes Could be the Next Big Trend in Prefab <https://www.thinkwood.com/blog/4-reasons-single-family-homes-could-be-the-next-big-trend-in-prefab>
- Mass Timber Gaining Mass Appeal <https://offsitebuilder.com/mass-timber-gaining-mass-appeal/>

Extending the Lesson (Optional)

ELEMENTARY SCHOOL RECOMMENDATIONS

The *Wood: A Scientific Wonder* lesson can be completed by upper elementary students, with support from educators and minor modifications to student activity sheets and the reading texts.

The following LEAF lessons may be more appropriate for lower-middle elementary students.

LEAF 4th Grade Forestry Lesson Guide, Lesson 2: Forests Built Wisconsin

- Students explore the importance of forests to early settlers and the Indigenous people living in Wisconsin at the time of settlement. Students participate in a mapping exercise to discover



the role forests played in the settling of Wisconsin and how it changed the lands of Wisconsin's First Nations. Students use evidence to write a paragraph about how settlement changed Wisconsin forests. <https://www.uwsp.edu/wp-content/uploads/2023/11/leaf-4-lesson-2-forests-built-our-state.pdf>

LEAF 2nd-3rd Grade Forestry Lesson Guide, Lesson 4: Forests Are Important to Me!

- Students explore and graph their personal forest values. Using a checklist, they discover how many of the forest products they use are made right here in Wisconsin and map them. As a conclusion, students create a collage and write about why they value forests. <https://www.uwsp.edu/wp-content/uploads/2023/11/leaf-2-3-lesson-4-forests-are-important-to-me.pdf>

LEAF K-1st Grade Forestry Lesson Guide, Lesson 4: Forest Products Time Machine

- Students learn about historical uses of forest resources. Students begin by sharing ways we use the forest while playing a game of Hot Pinecone. Next, the class explores forest resources used to create products of the past, while relating them to present-day goods. To conclude, students examine forest products and draw a picture of one they use every day. <https://www.uwsp.edu/wp-content/uploads/2023/11/leaf-k-1-lesson-4-forest-product-time-machine.pdf>

HIGH SCHOOL RECOMMENDATIONS

Consider expanding Activity 1 to use the Wood Database – Wood Filter to explore samples of hardwoods and softwoods from locations around the world. For Activity 2, require students find their own articles/websites to use to research the applications of mass timber.

Student Pages

See additional documents that will need to be included:

- Student Sheet: Branching Out - Wood Database Research – Activity 1
- Student Sheet: Branching Out - Building for the Future – Activity 2

Standards

WISCONSIN STANDARDS FOR SCIENCE

- **SCI.CC6.m** Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among their parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
- **SCI.PS1.A.m** The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.
- **SCI.ETS2.B.m** All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.



WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY

- **ELS.EX3.B.m** Examine the relationships among resource use, environmental quality, and human health and well-being.
- **ELS.EX5.C.m** Examine how historical and contemporary factors shape a sustainability issue.

WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS

- **ELA.R.6-8.1** Cite textual evidence to support an analysis of what the text says explicitly/implicitly and make logical inferences.
- **ELA.R.6-8.2** Summarize texts, from a variety of genres, to determine a theme or central idea and how it is developed by key supporting details over the course of a text.
- **ELA.W.6-8.3** Create writing that utilizes organization: introduce a topic; organize ideas, concepts and information; provide a concluding statement appropriate to the mode of writing.
- **ELA.W.6-8.4** Produce clear and coherent writing in which the development, organization and style are culturally sustaining and rhetorically authentic to task, purpose and audience.
- **ELA.SL.6-8.1a-d** Engage effectively in a range of collaborative discussions with diverse partners on topics, texts, and issues, building on others' ideas and expressing one's thinking clearly.
- **ELA.SL.6-8.2** Analyze the main ideas and supporting details presented in diverse media and formats and explains how it contributes to a topic, text, or issue under study.

Resources

- Brind'Amour, Molly and Bertrand, Savannah. (Sept 2023). Building Sustainably: Mass Timber Fact Sheet. Environmental and Energy Study Institute White Papers – Fact Sheets and Issue Briefs. https://www.eesi.org/files/FactSheet_Mass_Timber_2023.pdf
- Meier, Eric. (2024). The Wood Database, Wood Filter (online tool) https://www.wood-database.com/wood-filter/?fwp_janka=67.00%2C4630.00
- Meier, Eric. (2016). Wood: Identifying and Using Hundreds of Woods Worldwide. The Wood Database.
- U.S. Forest Service. (27 July 2022). World's tallest timber building opens. U.S. Department of Agriculture. <https://www.fs.usda.gov/inside-fs/delivering-mission/apply/worlds-tallest-timber-building-opens>



WOOD: A SCIENTIFIC WONDER

Branching Out

Activity 1 – Wood Database Research

BACKGROUND VOCABULARY FOR USING WOOD FILTER

(in order of appearance in wood profiles)

Heartwood: Dense inner part of a tree trunk; hardest timber comes from heartwood.

Sapwood: Soft, outer layers between the heartwood and the bark of the tree.

Distribution: Where trees grow throughout the world.

Specific gravity: Ratio of density of wood compared to density of water; wood with a specific gravity < 1 will float on water; Wood with a specific gravity > 1 will sink in water.

- **Density:** Relationship between the mass of wood and volume of wood (space it takes up); calculated by dividing mass by volume.

Janka hardness: Measures the resistance of wood to denting and wear; range is 0 to 4,000.

Module of rupture: Maximum load carrying capacity of wood when bent; range is 5,000-15,000 psi.

Elastic modulus: Measure of the wood's stiffness/strength; ability of wood to stretch without permanently losing its shape (getting stretched out); range is 800,000-2,500,000 psi.

Crushing strength: Maximum amount of compression (squeezing) wood can take before it fractures/breaks.

Shrinkage: How much the wood will decrease in size (contract/shrink) when it dries.

Grain or Texture: The arrangements of wood fibers seen on a cut surface of wood.

- **Coarse grain:** Wood with open growth rings not evenly spaced – a more irregular look.
- **Fine grain:** Wood with tighter growth rings more evenly spaced – a more even look.

End grain: The grain of wood seen when it is cut perpendicular to (across) its growth rings.

Rot resistance: Ability of wood to resist moisture and decay; woods with natural oils and dense fibers are usually more rot resistant.



Warping: When wood is bent out of shape; usually due to wetness or heat.

Workability: How easy the wood is to use with hand tools or machine tools.

Toxicity: Poisonous or able to cause harm.

Sustainability: Is the wood able to be used now and in the future? Is the tree a threatened or endangered species?

- **CITES Agreement/Appendices:** The Convention on International Trade in Endangered Species of Wild Fauna and Flora is an agreement between governments to help make sure trade does not threaten the survival of any species.
- **IUCN Red List:** Union for Conservation of Nature and Natural Resources list of threatened species.

INSTRUCTIONS

1. Access the Wood Database – Wood Filter using this link:

<https://www.wood-database.com/wood-filter/>

2. Check North America under **location** and only display common US woods under **Filter out obscure species**. There should be 81 species of wood remaining in the database.

3. Check Hardwood under **Wood Type**. Select one hardwood from the database to research. Record information about it in the Characteristics / Properties of Wood table.

4. Once you have finished learning about a hardwood species, go back and select Softwood under **Wood Type**. Select one softwood from the database to research. Record information about it in the table. Compare and contrast your hardwood and softwood samples.



CHARACTERISTICS / PROPERTIES OF WOOD

Hardwood:		Softwood:	
Where does it grow?		Where does it grow?	
How big does it get? (height and diameter)		How big does it get? (height and diameter)	
What does the wood look like? (heartwood, sapwood, grain)		What does the wood look like? (heartwood, sapwood, grain)	
What are some important properties of it? (specific gravity, hardness, strength, durability)		What are some important properties of it? (specific gravity, hardness, strength, durability)	
What is the wood used for?		What is the wood used for?	



CHARACTERISTICS / PROPERTIES OF WOOD

Hardwood:		Softwood:	
Is the wood good to work with? Explain.		Is the wood good to work with? Explain.	
Other interesting information about the wood		Other interesting information about the wood	
How is the use of the wood related to its properties?		How is the use of the wood related to its properties?	

Compare and Contrast the Hardwood sample you researched to the Softwood sample. How are they similar? How are they different?



WOOD: A SCIENTIFIC WONDER

Branching Out – Building for the Future – Activity 2

VOCABULARY:

- **Mass timber:** Wood products that are made by taking smaller wood elements (lumber, veneers, fibers) and connecting them together (with adhesives, screws, dowels) to create large building components like columns, beams, rafters, floors and more.
- **Cross laminated timber:** Engineered wood product made up of layers of kiln-dried dimension lumber oriented at right angles to one another and glued together to form panels.

World’s Tallest Timber Building Opens / Building Sustainably: Mass Timber

<p>How is wood being used to construct mass timber buildings?</p>	<p>What types of wood are used to construct mass timber buildings?</p>
<p>How is using mass timber in construction sustainable?</p>	<p>What are some benefits of building with mass timber?</p>



BUILDING FOR THE FUTURE CHALLENGE:

1. Research the use of mass timber and/or cross-laminated timber and how they are used in construction. Think about how mass timber could be used to improve the construction of single-family homes and make the construction of single-family homes more sustainable. These websites may help get you started:

- Cross Laminated Timber (CLT) in Home Building <https://www.buildwithrise.com/stories/cross-laminated-timber-clt>
- 4 Reasons Single-Family Homes Could be the Next Big Trend in Prefab <https://www.thinkwood.com/blog/4-reasons-single-family-homes-could-be-the-next-big-trend-in-prefab>
- Mass Timber Gaining Mass Appeal <https://offsitebuilder.com/mass-timber-gaining-mass-appeal/>

2. Design a single-family home that features the creative use of mass timber to make a better home in ways that are more sustainable.

3. Write a description (in paragraphs or captions) to explain how your design is an improved and sustainable model for single family home construction. Your description must include the following:

- Type of mass timber utilized and how it is being used to improve the construction of the home
- Why it's a sustainable choice (must include cited, evidence from one of the articles read in class or used in your research)

RUBRIC:

	Exemplary	Proficient	Developing	Beginning
Research & Citations	Two sources are cited OR a source not used in class is cited in the explanation of how home construction is sustainable.	At least one source is cited in the explanation of how home construction is sustainable (Can be source used in class)	Evidence from resources is used but not cited	No evidence is used/cited
Creative use of Mass Timber in Single-Family home	Mass timber is utilized in more than 3 areas in the design and included in captions or written explanation	Mass timber is utilized in at least 3 areas in the design of the single-family home and included in captions or written explanation	Missing 1 criteria required to be proficient	Missing 2 or more criteria required to be proficient
Sustainable use of Mass Timber in Construction of home	Sustainable use of mass timber is highlighted in more than 3 ways and included in captions or written explanation	Sustainable use of mass timber is highlighted in at least 3 ways and included in captions or written explanation	Missing 1 criteria required to be proficient	Missing 2 or more criteria required to be proficient
Product and Presentation	Design exceeds expectations for proficient and written work has minimal/no errors	Design is neatly drawn and labeled. Written work has no distracting errors	Design not drawn well or labeled; Distracting Errors	Design poorly drawn; Many errors