FOREST TO FRAME
Instruction Guide

Grades 9-12

Wood is a remarkable building material. It's strong, versatile and beautiful, and comes from a renewable resource. But did you know that wood can also be sturdy enough to frame high-rise buildings? An exciting new development in advanced wood products – collectively called mass timber – enables builders to construct large, multi-story structures with wood.

Oregon Forest Resources Institute's *Forest to Frame* publication and the accompanying *Forest to Frame* video explore mass timber and its many benefits. (For links to these materials, see the Resources section.)

This instruction guide offers ideas and information for using *Forest to Frame* in your high school classroom. It suggests ways to incorporate it into Career and Technical Education (CTE) classes that focus on architecture or construction, as well as into science, social studies and English language arts courses. Whatever way you decide to use *Forest to Frame*, we hope you'll enjoy investigating mass timber with your students.

Photo: LEVER Architecture

Background

Mass timber may revolutionize how we view building design and construction. In fact, many people in the construction industry say the 21st century will be known as the "age of timber." As our society faces rising population levels and a changing climate, mass timber offers many benefits. Some that you may explore with your classes include:

FIRE AND SEISMIC SAFETY. (CTE – Architecture) The massive wood used in mass timber construction must pass the same fire-safety tests as other building materials. During a fire, mass timber naturally creates an outer char layer that protects the timber's structural integrity. Mass timber also performs well in seismic load testing for earthquake safety.

LOWER CONSTRUCTION COST. (CTE – Construction) According to a recent study,* CLT construction can be less expensive than conventional steel and concrete construction. Mass timber components are often prefabricated off-site, reducing time and labor costs.

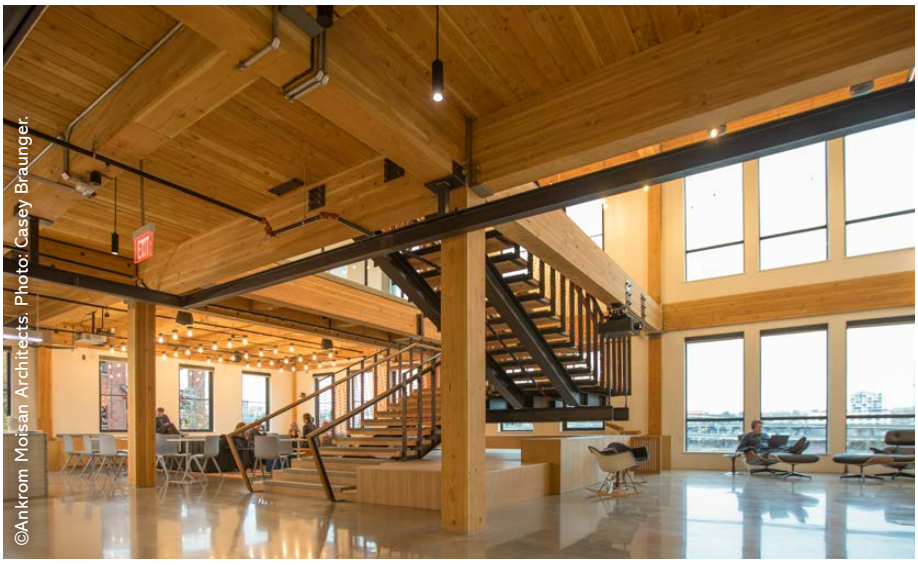
CARBON STORAGE. (Science) Mass timber and other wood products store carbon that was once part of the atmosphere. Trees remove carbon dioxide from the air through photosynthesis and store the carbon in their wood, thus helping offset greenhouse gas emissions – a major contributor to global climate change.

LOWER EMBODIED ENERGY. (Science) Wood products require significantly less energy to produce than other building materials. They are also lighter, which means less fuel is needed to transport them. These energy savings translate to fewer carbon emissions and a smaller carbon footprint.

SUPPORTING LOCAL COMMUNITIES. (Social Studies) Using mass timber products for building construction supports rural economic development. In Oregon, it drives demand for locally produced wood products and has the potential to revitalize many of Oregon's rural communities.

AESTHETIC QUALITY. (Social Studies) People often prefer wood's warmth, beauty and natural feel. Buildings with exposed wood structures provide a pleasing work environment to attract and keep skilled employees.

See the *Forest to Frame* publication for more information about the benefits of mass timber.



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* A Study of Alternative Construction Methods in the Pacific Northwest. http://walshconstructionco.com/wp-content/uploads/PNW-CLT-Feasibility-Report.pdf.

Questions for Discussion

You may use the *Forest to Frame* publication or 5-minute *Forest to Frame* video to introduce the topic of mass timber. Spark a student discussion, posing questions such as:

What is the "forest to frame" movement? How is it like or different from the "farm to table" movement?

How well does wood perform as a building material (including fire and seismic safety)?

What are the environmental costs and benefits of mass timber?

What are the health and aesthetic benefits of wood as a building material?

How does mass timber affect rural economic development?

In what ways does the mass timber movement intersect with issues related to rising population levels and changing climate?

Vocabulary

The following key terms are used in the *Forest to Frame* publication and video.

Biophilic design – building design that highlights the innate attraction people feel toward nature.

Carbon footprint – the amount of carbon dioxide produced (directly or indirectly) from human activities.

Cross-laminated timber (CLT) – a prefabricated wood panel made of several layers of lumber boards stacked and glued at right angles to one another.

Embodied energy – the sum of all the energy required to produce and deliver a good or service. The embodied energy includes mining, harvesting, manufacturing, transporting and so on.

Glulam or glue-laminated timber – a structural material made of layers of lumber bonded together with adhesives.

LEED (Leadership in Energy and Environmental Design) – a rating system administered by the U.S. Green Building Council and used to grade and certify buildings based on environmental attributes.

Life cycle assessment – a method for measuring the environmental impacts of materials or buildings over their entire lives.

Mass plywood panel (MPP) – a large, wood-based panel similar to CLT, but manufactured by adhering layers of veneer together.

Mass timber – a category of engineered wood products that includes CLT, glulam, MPP and others.

Photo: LEVER Architecture

Activity: Why Wood?

In this activity, students read specific pages in the *Forest to Frame* publication to analyze the claims made about mass timber and then summarize what they learn, in a letter or other product.

Materials: *Forest to Frame* video (see Resources), *Forest to Frame* publication, copies of the "How Good Is Wood?" student page, access to the internet.

Procedure:

1. Ask students to describe various properties of wood, listing their ideas on the board. (For example, wood is strong, has a grain and is renewable.) Ask them what questions or concerns they might have about using mass timber to construct mid- or high-rise buildings.

2. Provide students with copies of *Forest to Frame* and the "How Good Is Wood?" student page. Allow time for them to read various pages of the publication and examine claims made about mass timber, using the student page as a guide. (See the Answer Key for possible responses.)

3. Invite students to create a letter, email, poster or other product to present to a fictional supervisor or the school board, describing the benefits of using mass timber in a construction project such as a school. Where appropriate, students should document the evidence for each claim they make, citing information from the booklet or from their own research. See Resources for some additional sources.

More Activity Suggestions

Choose one or more activities to deepen your students' understanding of mass timber.

- **Building Case Studies.** (CTE – Architecture) Invite students to compare the different buildings highlighted in the *Forest to Frame* publication: Framework (page 4), Albina Yard (page 8), Oregon Forest Science Complex (page 13) and 38 Davis (page 16). Encourage them to compare the purpose of each building, as well as the number of stories and primary materials used in each. Have students select one of the buildings – or another mass-timber building of their choosing – to research further and write about in a case study.

- **Materials Lab.** (CTE – Construction) Challenge students to create prototypes of CLT or glulam and test their properties. For example, students might cut and glue pieces of wood, and compare the amount of weight they can hold when they are glued together alternating crosswise, versus all in one direction.

- **Life Cycle Assessment.** (Science) Guide students in analyzing the energy and carbon embodied in concrete, steel, mass timber and other construction materials. For each material, encourage students to follow its life cycle – from extraction or harvest of raw materials through manufacturing, transportation, installation, use, maintenance, and recycling or disposal – and identify the various points where energy and carbon are involved. They may also use the Carbon Estimator on the WoodWorks website (see Resources) to estimate the amount of carbon stored in different types of wood structures.

- **Career Profiles.** (Social Studies) Direct students to select one of the people highlighted in the *Forest to Frame* publication and conduct internet research to learn more about their work. Students may also examine other careers involved in mass-timber manufacturing, building or design. (For example, they may view footage of architect Michael Green in the OFRI Video Library, listed in Resources.)

- **Survey.** (English Language Arts) Instruct students to read the various quotes about the beauty of wood on page 17 of *Forest to Frame*, and then devise a survey to find out what others think about wood as a construction material. Have students analyze their results and present them to members of the community.

RESOURCES

Forest to Frame video. https://www.youtube.com/watch?v=gk_GfTI1b3I. A 5-minute overview of the benefits of mass timber in Oregon.

Forest to Frame publication. http://oregonforests.org/sites/default/files/2017-08/OFRI_ForestToFrame_WEB.pdf. An OFRI report on the mass-timber movement and its impact in Oregon.

Forests, carbon and climate change. http://www.oregonforests.org/node/93. Facts highlighting the value of forests and wood products for storing carbon.

OFRI video library. http://www.oregonforests.org/video_gallery. A selection of educational videos related to Oregon's forests.

TallWood Design Institute. http://www.tallwoodinstitute.org. A collaboration between Oregon State University and the University of Oregon focused on developing innovative wood-based building components.

Think Wood. www.thinkwood.com. Information and resources on the advantages of using wood in the built environment.

Why Build with Wood? http://whybuildwithwood.org/. A listing of environmental and economic benefits of building with wood.

Wood Stands Tall. http://www.oregonforests.org/sites/default/files/2017-05/OFRI_TallWood_handout_web.pdf. An overview of the benefits of building with Oregon-grown wood products.

WoodWorks. http://www.woodworks.org/. Education and resources on wood structures, including building case studies and a Carbon Estimator (at http://cc.woodworks.org/estimator.php?country=us).

OREGON FOREST LITERACY PLAN CONCEPTS

The Oregon Forest Literacy Plan, developed by a diverse statewide stakeholder group, identifies critical concepts for K-12 students in understanding Oregon forests. Concepts relevant to *Forest to Frame* include:

- Theme 2, D.2. Forests provide income for local, state, national and international economies. Oregon's forest sector is one of the state's largest economic sectors, and provides critical resources and products to the global marketplace, including softwood lumber, plywood and engineered wood products.
- Theme 2, D.3. Forest products are an important component of Oregon's "green" economy. They come from a renewable resource and store carbon, and most are also reusable and recyclable.

STANDARDS CONNECTIONS

NEXT GENERATION SCIENCE STANDARDS

Performance Expectations

- HS-ESS3-4. Earth and Human Activity. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Science and Engineering Practices

- Engaging in Argument from Evidence. Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations).

COMMON CORE STATE STANDARDS – ELA/LITERACY

- RST.11-12.7. Reading Science and Technical Subjects. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

ANSWER KEY TO "HOW GOOD IS WOOD?"

Following are possible answers from the *Forest to Frame* publication. Students may find additional ones.

Page 2

Issue: Climate change. Claim: Wood buildings combat carbon emissions. Evidence: Trees remove carbon from atmosphere and store it in wood.

Issue: Sustainable building. Claim: Wood is a sustainable building material. Evidence: Oregon forests are sustainably managed, and state law requires replanting forests.

Page 3

Issue: Cost of building construction. Claim: Wood construction costs less than other methods. Evidence: None given.

Page 7

Issue: Time is money. Claim: Wood buildings are faster to construct. Evidence: Can install panels instead of individual pieces of lumber.

Issue: Aesthetic quality. Claim: Wood is more beautiful. Evidence: People's positive reaction to wood.

Page 11

Issue: Fire safety. Claim: Mass timber is fire-resistant. Evidence: Mass timber passes two-hour fire tests.

Page 14

Issue: Embodied energy of materials. Claim: Wood products require less energy to produce than steel or concrete. Evidence: Graph showing energy requirements of different materials.

Page 15

Issue: Health and well-being of building occupants. Claim: Wood has a positive impact on people. Evidence: Studies show that biophilic design can stimulate brain activity and help people learn and heal.

Page 18

Issue: Revitalizing rural communities. Claim: New wood products will bring more jobs. Evidence: None given.

STUDENT PAGE

NAME _____

DATE _____

How Good Is Wood?

Read the following passages from *Forest to Frame*. For each passage, identify an issue the author or speakers claim mass timber can help solve. For each claim, note any evidence provided. Add evidence you find from other sources that supports or refutes the claim.

Passage	Issue	Claim for how mass timber solves issue	Evidence for claim	Evidence from other sources
"From Forest to Frame" (page 2)				
"Reshaping Skylines" (page 3)				
"Building with Mass Timber" (page 7)				
"CLT High-Rise Passes Fire Tests" (page 11)				
"Environmental Benefits of Wood" (page 14)				
"Biophilic Design" (page 15)				
"Supporting Rural Economic Development" (page 18)				