

Listed below are the Wisconsin learning standards correlations for the LEAF lessons in the 9-12 grade lesson guide. On the following pages, you will find the standards listed by lesson along with a brief explanation of how they are addressed by each lesson.

## **LESSON 1: FOREST ODYSSEY**

### **WISCONSIN STANDARDS FOR AGRICULTURE, FOOD AND NATURAL RESOURCES**

Students identify and describe ecosystem functions and natural processes in forests; compare and contrast the ecology, natural history, and human aspects of three different forest ecosystems in Wisconsin; list specific examples of how ecosystems are interrelated, how ecosystems change, and how ecosystems are sustained.

**Related Standards/Learning Priorities:** NR1.a; NR1.b; NR2.b; NR2.d; NR5.a; PS1.b; PS1.c;

### **WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY**

#### **Connect; ELS.C1.B.h**

Students compare and contrast the ecology, natural history, and human aspects of three different forest ecosystems in Wisconsin.

#### **Explore; ELS.EX2.A.h**

Students list specific examples of how ecosystems are interrelated, how ecosystems change, and how ecosystems are sustained.

#### **Explore; ELS.EX4.A.h**

Students identify and describe ecosystem functions and natural processes in forests, and list specific examples of how ecosystems are interrelated, how ecosystems change, and how ecosystems are sustained.

#### **Explore; ELS.EX5.C.h**

Students list specific examples of how ecosystems (including human components) are interrelated, how ecosystems change, and how ecosystems are sustained.

### **WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS**

#### **Reading for Informational Text; RI.9-10.2 & RI.11-12.2**

Students read Aldo Leopold's "Odyssey" tracing the progress of atoms x and y through the natural process. Students then present a summary of the process to the class.

#### **Reading for Informational Text; RI.9-10.3 & RI.11-12.3**

Students discuss and evaluate Leopold's writing including style, clarity, and development of concepts and themes.

#### **Writing; W.9-10.3 (A-E) & W.11-12.3 (A-E)**

Students write a narrative essay from the perspective on an atom combining scientifically accurate and creative elements.

#### **Writing; W.9-10.7 & W.11-12.7**

Students conduct research on their assigned forested ecosystem, synthesizing information from multiple sources.

### **Speaking and Listening; SL.9-10.4 & SL.11-12.4**

Students present findings from their research in an organized manner that is appropriate to the audience.

## **NEXT GENERATION SCIENCE STANDARDS**

### **Interdependent Relationships in Ecosystems; HS-LS1-5**

#### **Practices: Developing and Using Models**

#### **DCI: LS1.C: Organization for Matter and Energy Flow in Organisms**

#### **CCC: Energy and Matter**

Students analyze the process of photosynthesis and discuss the role of producers in fixing energy in the systems. Students are presented with a scenario in which producers are removed from an ecosystem and discuss the impacts it would have on other organisms, including humans.

### **Matter and Energy in Organisms and Ecosystems; HS-LS1-6**

#### **Practices: Constructing Explanations and Designing Solutions**

#### **DCI: LS1.C: Organization for Matter and Energy Flow in Organisms**

#### **CCC: Energy and Matter**

Students discuss how plants and animals acquire and use nutrients. Students describe how a variety of natural processes contribute to the cycling of matter. They create a journey of an atom through a forest ecosystem based on the science-based creative essay “Odyssey” by Aldo Leopold.

### **Matter and Energy in Organisms and Ecosystems; HS-LS1-7**

#### **Practices: Developing and Using Models**

#### **DCI: LS1.C: Organization for Matter and Energy Flow in Organisms**

#### **CCC: Energy and Matter**

Students describe how different natural processes contribute to the flow of energy in ecosystems. Students work in groups to research and create food webs for three different forest ecosystems.

### **Matter and Energy in Organisms and Ecosystems; HS-LS2-5**

#### **Practices: Developing and Using Models**

#### **DCI: LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**

#### **CCC: Systems and System Models**

Students discuss how plants and animals acquire and use nutrients. Students describe how a variety of natural processes contribute to the cycling of matter. They create a journey of an atom through a forest ecosystem based on the science-based creative essay “Odyssey” by Aldo Leopold.

## **LESSON 2: A HISTORY OF SUCCESSION**

### **WISCONSIN STANDARDS FOR AGRICULTURE, FOOD AND NATURAL RESOURCES**

Students describe the process of forest succession; list some of the major causes of forest ecosystem change in Wisconsin over the last 64 million years; describe, in general, the natural features and current land use patterns in Wisconsin; explain why the distribution of specific tree species in Wisconsin has increased and decreased throughout history; identify and describe the current causes of forest ecosystem change in Wisconsin.

**Related Standards/Learning Priorities: NR1.a; NR1.b; NR2.b; NR2.c; NR2.d; NR4.a; PS1.a; PS2.a**

## WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY

### **Connect; ELS.C1.B.h**

Students describe, in general, the natural features and current land use patterns in Wisconsin.

### **Explore; ELS.EX4.B.h**

Students investigate changes in Wisconsin land use before and after European settlement.

### **Explore; ELS.EX5.B.h**

Students explain why the distribution of specific tree species in Wisconsin has increased and decreased throughout history.

## WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS

### **Reading for Informational Text; RI.9-10.1 & RI.11-12.1**

Students use lecture notes and handouts to create a forest timeline and tree profile for their assigned species.

### **Writing; W.9-10.8 & W.11-12.8**

Students compile multiple resources to write a short summary describing a current influence on Wisconsin's forests.

## NEXT GENERATION SCIENCE STANDARDS

### **Interdependent Relationships in Ecosystems; HS-LS2-6**

#### **Practices: Developing and Using Models**

#### **DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

#### **CCC: Stability and Change**

Students use a variety of resources to assert a claim based on the changes the populations of six different tree species have undergone throughout Wisconsin's history, and then present their evidence and reasoning to the class.

## WISCONSIN MODEL ACADEMIC STANDARDS FOR SOCIAL STUDIES

### **Geography: People, Places, and Environments; A.12.1**

Students are presented with information (maps, lecture, video, and text) about the human and natural influences that caused change on the Wisconsin landscape. Students use the information to describe the landscape and how it has changed through time.

### **History: Time, Continuity, and Change; B.12.3**

Students use a timeline to divide Wisconsin's history into four major periods of forest disturbance: Pre-Human, Native American, European Settlement and Exploitation, and Forest Conservation. Students describe the large-scale natural and social forces and the major events of each period and compare and contrast the disturbances in each.

## **LESSON 3: FOREST BIODIVERSITY: TREE CASE STUDIES**

## WISCONSIN STANDARDS FOR AGRICULTURE, FOOD AND NATURAL RESOURCES

Students define the terms related to ecology and biodiversity; explain how regional climatic and geologic differences contribute to biodiversity in Wisconsin; describe four characteristics generally used to distinguish forests.

**Related Standards/Learning Priorities:** NR1.a; NR1.b; NR2.b; NR2.c; NR2.d; PS2.a

## **WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY**

**Connect; ELS.C1.B.h**

Students describe forest ecosystems of Wisconsin.

**Explore; ELS.EX2.A.h**

Students explain how regional climatic and geologic differences contribute to biodiversity in Wisconsin.

**Explore; ELS.EX2.B.h**

Students illustrate how climate and glacial history influence the range of different tree species in Wisconsin.

**Explore; ELS.EX3.B.h**

Students use specific information about Wisconsin tree species to describe healthy levels of forest biodiversity.

## **WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS**

**Speaking and Listening; L.9-10.5 & L.11-12.5**

Students determine or clarify the meaning of unknown or multiple-meaning words and phrases related to biodiversity (see page 84 for full list) and forest structure (page 87).

**Speaking and Listening; SL.9-10.1C & SL.11-12.1C**

Students propel conversations by posing and responding to questions on several topics including, “What factors contribute to or limit forest biodiversity?” and “How do we know how much biodiversity a forest should have?”

**Speaking and Listening; SL.9-10.1 & SL.11-12.1**

Students participate in a small-group collaborative discussion focused on the question, “How does the climate and glacial history of Wisconsin affect the state’s biodiversity?” Students use discussion to build on others’ ideas and clearly express their own.

**Speaking and Listening; SL.9-10.4 & SL.11-12.4**

Students present summary of their tree profile in an organized manner that is appropriate to the audience.

## **NEXT GENERATION SCIENCE STANDARDS**

**Interdependent Relationships in Ecosystems; HS-LS2-7**

**Practices: Constructing Explanations and Designing Solutions**

**DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

**LS4.D: Biodiversity and Humans**

**ETS1.B: Developing Possible Solutions**

**CCC: Stability and Change**

Students discuss and brainstorm questions about biodiversity, review case studies about biodiversity issues and specific Wisconsin trees, develop insights on the importance of

biodiversity in forests, and participate with students from other case studies to form an answer to the question, “What is a healthy level of biodiversity?”

## **LESSON 4: THE FOREST MARKETPLACE**

### **WISCONSIN STANDARDS FOR AGRICULTURE, FOOD AND NATURAL RESOURCES**

Students list factors that can influence the supply of and demand for forest resources; differentiate between primary and secondary wood products, nonwood products, and forest services, and give examples of each; describe the general supply of and demand for forest resources; identify the variables that make up production cost and the price of goods in a competitive global marketplace; explain the role of governments in the global marketplace for wood products and list ways they support businesses, workers, communities, and the environment; identify specific ways the use of Wisconsin’s forests is influenced by the decision of local and foreign businesses and governments.

**Related Standards/Learning Priorities: NR3.a; PS3.d**

### **WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY**

**Explore; ELS.EX2.C.h**

Students participate in activities that illustrate economic and environmental factors that influence the supply and demand of forest products in Wisconsin and the rest of the world.

**Explore; ELS.EX3.C.h**

Students learn how diversity in Wisconsin’s forest ecosystems contribute to supply and demand of forest products and economic sustainability.

**Explore; ELS.EX4.B.h**

Students list factors that can influence the supply of and demand for forest resources, and identify the variables that make up production costs and the price of forest products in a competitive, global marketplace.

**Explore; ELS.EX5.B.h**

Students learn how changes in forest health affect supply of forest products.

**Explore; ELS.EX5.C.h**

Students predict how changes in social and economic conditions can affect the use of Wisconsin’s forest resources and those of other nations.

**Engage; ELS.EN6.A.h**

Students predict how changes in social and economic conditions can affect the use of Wisconsin’s forest resources and those of other nations, affecting the sustainability of the forest ecosystem.

### **WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS**

**Language; L.9-10.5 & L.11-12.5**

Students determine or clarify the meaning of unknown or multiple-meaning words and phrases related to veneer, a market economy, and forest products and services.

### **Speaking and Listening; SL.9-10.2**

Students interpret and integrate information from diverse media or formats including a DVD and several charts and graphs.

### **Speaking and Listening; SL.9-10.1C & SL.11-12.1C**

Students propel conversations by posing and responding to questions on several topics including: the impact of economics on forest management and relationships between price/profit and supply/demand.

### **Speaking and Listening; SL.9-10.1 & SL.11-12.1**

Students participate in a small-group collaborative discussion focused on one factor that can affect forests in Wisconsin (discussion cards from teacher page 14). Students use discussion to build on others' ideas and clearly express their own.

### **Writing; W.9-10.2 & W.11-12.2**

Students write a 1-2 page summary of their answer to one question from the discussion card. Their summary should state the potential impact(s) and provide information and evidence to support that claim.

### **Writing; W.9-10.7 & W.11-12.7**

Students research a variety of sources to address one of the scenarios outlined on the discussion cards.

## **WISCONSIN STANDARDS FOR MARKETING, MANAGEMENT, AND ENTREPRENEURSHIP**

### **B.12.2; Free Enterprise**

Students define economic terms, learn how price is determined by supply and demand, and describe the factors that influence supply, demand, and cost of production.

### **B.12.3; Free Enterprise**

Students describe the role of government by using a circular flow diagram. Students discuss the role of government in protecting environmental services, assisting businesses, and providing government services and infrastructure.

## **WISCONSIN STANDARDS FOR MATHEMATICS**

### **N-Q.1; Quantities**

Students use the profit equation using and interpreting units.

### **A-REI.3; Reasoning with Equations**

Students solve the linear profit equation.

### **F-IF.4; Interpreting Functions**

Students interpret graphs to determine relationships involved in the profit equation.

### **F-BF.1 B&C; Building Functions**

Students describe the relationship between profit and loss using the profit equation.

### **F-LE.1; Linear, Quadratic, and Exponential Models**

Students use the profit equation with various charts, graphs, and tables to model situations.

### **F-LE.2; Linear, Quadratic, and Exponential Models**

Students use the profit equation with various charts, graphs, and tables to construct a profit equation.

### **S-ID.1L; Interpreting Categorical and Quantitative Data**

Students plot the supply and demand of forest resources on graphs.



## S-ID.5; Interpreting Categorical and Quantitative Data

Students analyze the supply and demand data of forest resources.

## NEXT GENERATION SCIENCE STANDARDS

### Human Sustainability; HS-ESS3-2

**Performance Expectation:** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.\* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen]

#### **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).

#### **DCI:**

##### **ESS3.A: Natural Resources**

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

##### **ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (*secondary*)

##### **LS4.D: Biodiversity and Humans**

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (*secondary*)
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (*secondary*) (*Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.*)

##### **ETS1.B: Developing Possible Solutions**

- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (*secondary*)

### ***Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World***

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Analysis of costs and benefits is a critical aspect of decisions about technology.

### ***Connections to Nature of Science***

### **Science Addresses Questions About the Natural and Material World**

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Students predict changes in Wisconsin and global forest use resulting from changes in social and environmental conditions.

## **MODEL ACADEMIC STANDARDS FOR SOCIAL STUDIES**

### **A.12.4; Geography: People, Places, and Environments**

Students use economic principles, supply and demand statistics, and global production cost data to discuss how increases in population might affect the use of forests in Wisconsin and other nations.

### **A.12.5; Geography: People, Places, and Environments**

Students analyze global supply and demand statistics and production costs and discuss the advantages and disadvantages that countries have in a global system of trade.

### **D.12.3; Economics: Production, Distribution, Exchange, Consumption**

Students use supply and demand statistics and relative production costs to predict how changes in social and environmental conditions will affect the use and trade of forest resource between Wisconsin and the nations of the world.

### **D.12.10; Economics: Production, Distribution, Exchange, Consumption**

Students read a newspaper article describe the economic conditions which determine the price, availability, origin, and type of products being bought and sold.

## **LESSON 5: FOREST SCIENCE AND TECHNOLOGY**

### **WISCONSIN STANDARDS FOR AGRICULTURE, FOOD AND NATURAL RESOURCES**

Students list common pollutants emitted during the manufacture and transport of concrete, steel and wood; describe the costs and benefits of different energy sources; compare and contrast the energy inputs and pollution outputs required for manufacturing; describe the processes involved in the manufacture of dimensional lumber; define the relationship that time scale and landscape scale have with sustainable forest management; identify social, economic, and ecological values associated with forests and explain how these values translate into management objectives; formulate solutions to forestry challenges; explain how different forest challenges may change over time.

**Related Standards/Learning Priorities:** NR1.a; NR2.a; NR2.b; NR2.c; NR2.d; NR3.a; NR5.a

### **WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY**

**Explore;** ELS.EX2.A.h



Students analyze various inputs and outputs involved in the manufacture and output of different natural resources.

**Explore; ELS.EX2.C.h**

Students identify social, economic, and ecological values associated with forests and explain how these values translate into management objectives.

**Explore; ELS.EX4.A.h**

Students define the relationship that time scale and landscape scale have with sustainable forest management; students describe how different forest management and production techniques can improve the environmental impacts of wood use.

**Explore; ELS.EX4.B.h**

Students identify social, economic, and ecological values associated with forests and explain how these values translate into management objectives.

**Explore; ELS.EX5.A.h**

Students formulate solutions to forestry challenges using technology, forest management, and consumer action.

**Explore; ELS.EX5.C.h**

Students explain how forest management challenges may change over time.

**Engage; ELS.EN6.A.h**

Students identify social, economic, and ecological values associated with forests and explain how these values translate into management objectives.

**Engage; ELS.EN6.C.h**

Students formulate solutions to sustainable forestry challenges using technology, forest management, and consumer action.

## **WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS**

### **Language; L.9-10.5 & L.11-12.5**

Students determine or clarify the meaning of various pollutants in “Pollutant Match Up” (student page 1).

### **Speaking and Listening; SL.9-10.1 & SL.11-12.1**

Students initiate and participate in a range of collaborative discussions (partners, small groups, whole-class) about environmental impacts of wood, concrete and steel and the cost of wood production. Students work in groups to write a proposal that outlines solutions for reducing the environmental impact of forest products.

### **Speaking and Listening; SL.9-10.4 & SL.11-12.4**

Students present a life cycle analysis for one of three materials (wood, steel, and concrete). Students also share their ideas for reducing pollution production and energy use in transportation.

## **WISCONSIN STANDARDS FOR MARKETING, MANAGEMENT, AND ENTREPRENEURSHIP**

### **D.12.2; Marketing Functions**

Students develop simple life cycle analyses for concrete, steel, and wood.

### **D.12.5; Marketing Functions**

Students study the benefits and costs of different energy sources, types of pollution, and the overall environmental impact of concrete, steel, and wood production. Students describe current challenges to forests and predict future impacts. Students use their knowledge to develop and discuss solutions.

## WISCONSIN STANDARDS FOR MATHEMATICS

### **N-Q.1; Quantities**

Students determine how much energy is used to transport materials most efficiently using units and comparing different scenarios.

### **N-Q.2; Quantities**

Students determine how much energy is used to transport materials most efficiently using units and comparing different scenarios.

### **N-Q.3; Quantities**

Students determine how much energy is used to transport materials most efficiently using units and comparing different scenarios and determine which method of shipment is best.

### **A-CED.1; Creating Equations**

Students use equations to calculate energy used.

### **F-IF.4; Interpreting Functions**

Students use the results of their calculations about energy use to interpret key features of graphs.

### **F-IF.5; Interpreting Functions**

Students use the results of their calculations about energy use to interpret key features of graphs.

### **F-IF.9; Interpreting Functions**

Students use the results of their calculations about energy use and compare their equation and table.

### **F-BF.1B; Building Functions**

Students use the results of their energy calculations to build a function.

### **F-LE.1B; Linear, Quadratic, and Exponential Models**

Students use the results of their calculations about energy use construct models of energy use.

### **F-LE.5; Linear, Quadratic, and Exponential Models**

Students interpret expressions based on the situation they model.

### **S-ID.1; Interpreting Categorical and Quantitative Data**

Students use charts and graphs to summarize their work.

## NEXT GENERATION SCIENCE STANDARDS

### **Human Sustainability; HS-ESS3-2**

**Performance Expectation:** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.\* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen]

### **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).

**DCI:****ESS3.A: Natural Resources**

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary)*

**LS4.D: Biodiversity and Humans**

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(secondary)*
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary)* (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary)*

***Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World***

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Analysis of costs and benefits is a critical aspect of decisions about technology.

***Connections to Nature of Science*****Science Addresses Questions About the Natural and Material World**

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Students work in small groups to develop a proposal that sues technology to reduce the environmental impact of wood manufacture and use. Students present their proposal to the class.

**Human Sustainability; HS-ESS3-4**

**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.\*** [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design

solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

#### **Practices: Constructing Explanations and Designing Solutions**

- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

#### **DCI:**

#### **ESS3.C: Human Impacts on Earth Systems**

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

#### **ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (*secondary*)

#### **CCC:**

#### **Stability and Change**

- Feedback (negative or positive) can stabilize or destabilize a system.

#### ***Connections to Engineering, Technology, and Applications of Science***

#### **Influence of Science, Engineering, and Technology on Society and the Natural World**

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Students analyze the benefits and costs of different sources of energy. They use life cycle analyses to describe the energy use and pollution output of concrete, steel, and wood manufacture and use. They attempt to use technology, forest management activities, and consumer actions to minimize the environmental cost of resource use.

## **CAREERS EXPLORATION**

### **WISCONSIN STANDARDS FOR ENVIRONMENTAL LITERACY AND SUSTAINABILITY**

#### **Engage; ELS.EN6.C.e**

Students learn about jobs related to forests and forestry.

### **WISCONSIN STANDARDS FOR ENGLISH LANGUAGE ARTS**

#### **Language; L.9-10.5 & L.11-12.5**

Students determine or clarify the meaning of unknown or multiple-meaning words and phrases related to jobs in natural resources (soil and water conservation, bachelor's degree, emphasis of study, etc.)

#### **Speaking and Listening; SL.9-10.1C & SL.11-12.1C**

Students propel conversations by posing and responding to questions on several topics including: jobs in the natural resource field and best qualifications for those jobs.

#### **Writing; W.9-10.7 & W.11-12.7**

Students research natural resource career fields and vacancy announcements on the internet.