



DRAFT

Conceptual Guide for K-12 Wildland Fire Education in Wisconsin

LEAF

Wisconsin Center for Environmental Education
College of Natural Resources
University of Wisconsin-Stevens Point
Stevens Point, WI 54481
PH (715) 346-4956
FAX (715) 346-3025
Email: leaf@uwsp.edu
www.uwsp.edu/cnr/leaf

LEAF Staff

Sterling Strathe – Director
Sunshine Buchholz – Forestry Education Specialist
Sarah Gilbert – Forestry Education Specialist
Nick Hylla – Forestry Education Specialist
Jeremy Solin – School Forest Education Specialist

LEAF Advisory Committee Members (2005)

Miles Benson

The Forest History Association of Wisconsin, Inc.

Scott Bowe

University of Wisconsin-Madison,
Department of Forest Ecology & Management

Randy Champeau

Wisconsin Center for Environmental Education

John DuPlissis

University of Wisconsin-Stevens Point, College of
Natural Resources

Gail Epping Overholt

Wisconsin Association for Environmental Education

Genny Fannucchi

Wisconsin Department of Natural Resources -
Division of Forestry

Gail Gilson-Pierce

Trees for Tomorrow

David Gliniecki

Wisconsin Association of Agricultural Educators

Earl Gustafson

Wisconsin Paper Council

Terri Heyer

United States Department of Agriculture Forest
Service

John Houghton

University of Wisconsin-Stevens Point, College of
Natural Resources

Bill Klase

University of Wisconsin Extension, Basin Educator

Sherry Klosiewski

Wisconsin Department of Natural Resources -
Bureau of Parks and Recreation

Eden Koljord

Wisconsin Forest Resources Education Alliance

Shelley Lee

Wisconsin Department of Public Instruction

Nancy Livingston

Wisconsin Woodland Owners Association

Colette Matthews

Wisconsin County Forest Association

Wendy McCown

Wisconsin Department of Natural Resources -
Division of Forestry

Barb Thompson

West Salem School District

Dennis Yockers

Wisconsin Center for Environmental Education

Conceptual Framework Workshop Participants

Jolene Ackerman

Wisconsin Department of Natural Resources
(Wildland-Urban Interface Coordinator)

Jake Bonack

Wisconsin Department of Natural Resources
(Forester Ranger)

Steve Courtney

Wisconsin Department of Natural Resources
(Area Forestry Leader)

John DuPlissis

WI Society of American Foresters (Chair)

Genny Fannucchi

Wisconsin Department of Natural Resources
(Bureau Forestry Services)

Lindsay Haas

Wisconsin Department of Natural Resources
(Natural Resource Educator)

Brook Hushagen

Wisconsin Department of Natural Resources
(Forestry Technician)

Chad Janowski

Shawano Community High School

Patricia Marinac

Appleton Area School District

James R. Miller

Wisconsin Department of Natural Resources
(Retired)

Catherine Regan

Wisconsin Department of Natural Resources
(Wildland Fire Prevention Specialist)

Paul Samerdyke

Wisconsin Department of Natural Resources
(Prescribed Burn Team)

Matt Schoonover

Wisconsin Department of Natural Resources
(Whiting Ranger Station)

Scope and Sequence Workshop Participants

Patrick Arndt

Berlin High School

Andrea Blattler

Lincoln High School

Joan Dickrell

St. Vincent de Paul School

JoAnn Goodness

Assumption Middle School

Jeanette Handrich

Jackson Environmental Discovery Center

Chad Janowski

Shawano Community High School

Casey Nye

Bannach Elementary School

Mary Rohde

Kate Goodrich Elementary School

Melissa Theusch

Jackson Environmental Discovery Center

Betty Wright

Jackson Environmental Discovery Center

Conceptual Guide Reviewers

Jolene Ackerman

Wisconsin Department of Natural Resources (Wildland-Urban Interface Coordinator)

Blair W. Anderson

Wisconsin Department of Natural Resources (Chief, Forest Fire Management)

Tim Banaszak

Wisconsin Department of Natural Resources (Forestry Technician)

Jake Bonack

Wisconsin Department of Natural Resources (Forester Ranger)

Steve Courtney

Wisconsin Department of Natural Resources (Area Forestry Leader)

John DuPlissis

WI Society of American Foresters (Chair)

Michael Engel

U.S. Fish and Wildlife Service (Private Lands Office)

Melissa M. Gillaume

Wisconsin Department of Natural Resources (Wisconsin Dells Ranger Station)

Gail Gilson-Pierce

Trees for Tomorrow (Past Director)

Jim Gobel

Wisconsin Department of Natural Resources (Spoooner Ranger Station)

Lindsay Haas

Wisconsin Department of Natural Resources (Natural Resource Educator)

Jeanette Handrich

Jackson Environmental Discovery Center

Janet Hutchens

Wisconsin Department of Natural Resources (PLT Interim State Coordinator)

Brad Kildow

Wisconsin Department of Natural Resources (Whiting Ranger Station)

Mary Ann Kroehn Buenzow

Wisconsin Department of Natural Resources (Janesville County Forester)

James R. Miller

Wisconsin Department of Natural Resources (Retired)

Carrie A. Morgan

Wisconsin Department of Natural Resources (Environmental Education Specialist)

Casey Nye

Bannach Elementary School

Ted Pyrek

Wisconsin Department of Natural Resources (Dodge County Forester)

Catherine Regan

Wisconsin Department of Natural Resources (Wildland Fire Prevention Specialist)

Sean Sallmann

U.S. Fish and Wildlife Service (Horicon National Wildlife Refuge)

Jean Schaeppi-Anderson

U.S. National Park Service (Cultural Resource/Interpretive Specialist)

Table of Contents

LEAF Overview.....	5
Rationale for Wildland Fire Education in Wisconsin.....	6
Conceptual Framework Overview.....	7
Conceptual Framework.....	8
What is wildland fire.....	8
Why is wildland fire important.....	10
How do we manage wildland fire.....	11
What is the future.....	12
Vocabulary.....	14
Scope and Sequence Overview.....	16
Scope and Sequence.....	17
WI Model Academic Standards.....	21
References.....	25

What is LEAF?

LEAF (Learning, Experiences, & Activities in Forestry) is Wisconsin's K-12 forestry education program. It was created to provide comprehensive forestry education for Wisconsin's kindergarten through 12th grade students. In 2001, Wisconsin K-12 forestry education stakeholders met to discuss the current status of and the needs for Wisconsin-based K-12 forestry education. Although a variety of programs existed, voids were identified in delivery and dissemination of educational materials and services. To present a more unified effort, stakeholders supported the development of a comprehensive program that would cooperate with existing efforts.

During the spring of 2001, legislation was written to establish the LEAF Program as a partnership between the Wisconsin Department of Natural Resources - Division of Forestry and the Wisconsin Center for Environmental Education at the College of Natural Resources at the University of Wisconsin-Stevens Point. Funding for the program is provided through a surcharge on the sale of seedlings from Wisconsin Department of Natural Resources - Division of Forestry nurseries.

Mission

The mission of LEAF is to initiate and facilitate the development, dissemination, implementation, and evaluation of forestry education programs within Wisconsin schools.

Goals

- To document forestry concepts Wisconsin K-12 students should learn.
- To develop "Wisconsinized" K-12 forestry education materials for use in the classroom and field.
- To build partnerships with other Wisconsin K-12 forestry education stakeholders and support their efforts.
- To provide teachers professional development opportunities in forestry education including college credit courses and workshops.
- To assist schools with the infusion of standards-based* forestry education concepts into their classroom curriculum. (*See page 24 for an explanation of the Wisconsin Model Academic Standards.)
- To assist schools forests with site management and education plan development, networking, and training programs.

LEAF Services

Professional Development – Graduate level courses (face-to-face, on-line) and workshops for educators, resource professionals, and forest landowners.

School Forest Program – Education and management plan development assistance and resources.

Resources – K-12 forestry education lesson guide with supplements, web-based materials including on-line tree ID key, additional publications.

Community Connections – Presentations and workshops at events state-wide.

Consulting – Assistance with forestry education adoption for school districts, outdoor education facilities, and various organizations.

A Rationale for Wildland Fire Education in Wisconsin

Wildland fire has become a major issue that agencies have had to deal with over the past several years. Large forested areas of the west and south have burned as a result of drought, hot weather, fuel load, and human carelessness. Human life, human property, forest resource waste, and agency fire budgetary drains have brought about policy changes related to the management of federal lands. Wildland fire continues to have negative connotations for much of the American public due to mishaps like the Los Alamos prescribed burn that unintentionally burned 50,000 acres, 200 homes, and caused the evacuation of 15,000 people.

Here in Wisconsin and the Great Lakes Region our fire regimes, population density, and culture differ from those of the west and south. Although historically Wisconsin has experienced major catastrophic fire events, conditions in recent years have limited large scale fire. Even so, Wisconsin Department of Natural Resources fire crews annually respond to 1,500 fires that burn over 5,000 acres. Catastrophic fires, like the Cottonville Fire in 2005, still threaten lives, property, and resources.

The wildland human interface is increasing in Wisconsin as each year 3000 new parcels are carved out of existing forest land holdings. On many of these parcels, homesteads, summer homes, and hunting cabins are being built. More and more people are moving to the woods and estimates predict that housing density in Wisconsin's forested regions will continue to rise. If Wisconsin experiences a large catastrophic fire event, the cost in just human property would be extremely large.

How do most of these fires start? Ninety percent of all forest related fires in Wisconsin are started by humans. As more individuals move into the wildland interface, the number of fires and the possibility for catastrophic fires increase. Burning debris, sparks from equipment like chain saws and all terrain vehicles, and campfires/ash disposal are the most common ways that humans cause fire. Each of these modes of fire generation are preventable. Education is a key prevention tool to develop an informed and caring citizenry that will take action to prevent useless fires and that support the use of prescribed burning as a management tool.

Fire prevention education materials focused on Wisconsin are incomplete at this time. The Wisconsin DNR Division of Forestry has minimal teaching resources for K-12 forest fire education.

As we look at the existing materials available for K-12 forest fire education several things are apparent. Some are more user friendly for teachers. Some have many bells and whistles to captivate today's video game generation. But in all of these materials, there are common themes, overriding fire principles, and localized information related to a specific region of the country. Utilizing these existing materials in Wisconsin to teach about Wisconsin's fire regimes may provide a disjunctive message. Yet, utilizing these resources as a foundation for developing a comprehensive program for Wisconsin makes a great deal of sense.

CONCEPTUAL FRAMEWORK

Natural resource topics such as wildland fire cover a wide array of information, which could be overwhelming to understand and to teach. This framework divides wildland fire education into teachable concepts, organized in a manner that makes them easy to communicate. **The framework is not a curriculum itself**, but the structure around which activities and lessons in the K-12 Wildland Fire Supplement will be built. The framework is designed to evolve as wildland fire education evolves. We encourage educators to modify and add to this framework as curriculum is developed to best meet their needs.

Detailed wildland fire principles are not listed in this document because they are beyond the scope of this framework and K-12 education. Specific details related to the concepts in this framework are used in activities to enhance understanding and provide examples.

Many individuals and organizations provided input in developing this conceptual framework. Initially, wildland fire concepts and ideas were gathered from professionals in natural resources and wildland fire fields. Concepts were also gathered for textbooks and from existing state and national wildland fire education lesson guides. Educators and wildland fire professionals then highlighted areas of importance within the information that had been gathered. Existing conceptual frameworks such as the LEAF Program's *A Conceptual Guide to K-12 Forestry Education in Wisconsin* and the *K-12 Energy Education Program—A Conceptual Guide in Wisconsin* were used as references for the structure of this document.

This framework is organized under four themes posed as questions:

- What Is Wildland Fire?
- Why Is Wildland Fire Important?
- How Do We Manage Wildland Fire?
- What Is the Future?

Each theme is followed by concepts that address the question, and the concepts are further divided into numbered subconcepts. The themes are arranged so that they build upon each other. Students progress from a basic understanding of forests to the understanding of forests in a social context. Definitions of some terms relative to use in this document are provided for clarity.

Theme 1: WHAT IS WILDLAND FIRE?

The concepts in this theme provide students with a fundamental understanding of wildland fire and the factors that determine its ignition and behavior. The concepts help students understand the interrelationship between fire, human populations, and the rural landscape.

Definition of Wildland Fire

By distinguishing between wildfire and prescribed fire and understanding the causes of each, students develop a context for understanding the difference between destructive and beneficial fires.

1. In Wisconsin, there are two main types of **wildland fire**: **wildfire** and **prescribed fire**. Wildfires start without the intent of the landowner or land manager and are unwanted. Prescribed fires are planned and controlled to meet the goals of a landowner or land manager.
2. The ignition of wildland fire can be caused by human activity (e.g., **debris burning** and other outdoor burning, machine sparks, children playing with matches, power lines, fireworks) or natural sources (e.g., lightning, spontaneous combustion). Human activity is responsible for most wildland fires in Wisconsin.

Fire Behavior

An understanding of the factors that influence and determine fire behavior helps students recognize dangerous fire conditions and properly extinguish campfires. Students also build a foundation for understanding the interaction between fire and the environment.

3. To exist, fire requires oxygen, heat, and fuel – collectively known as the **fire triangle**. Under most conditions, the three factors can be manipulated to slow or stop the spread of fire.
4. Scientific principles that describe the transfer and transformation of energy help us understand and predict **fire behavior**.
5. Fire behavior is influenced by **topography**, **weather**, and **fuel characteristics**. The **fire season** is determined by seasonal changes in weather and fuel.
6. The three basic types of fire behavior are named according to the vegetation layer in which the fire is burning: **ground fire**, **surface fire**, and **crown fire**. Wildland fire can be further characterized by the **rate of spread**, **flame length**, and **heat per unit area**.

Fire Regimes

The study of fire regimes allows students to conceptualize fire within earth's systems. Students place wildland fire in both a landscape and historical context.

7. Humans are a fundamental component of ecosystems. Earth's **fire regimes** have been shaped by human influences.
8. Regions in Wisconsin and the United States differ in **climate**, **topography**, **land cover**, and **land use**. These differences create distinct fire regimes.

9. Fire regimes change through time due to factors such as forest **succession**, human activity, **climate change**, **species introduction**, and **species extirpation**.

Fire Ecology

By examining the influence that wildland fire has on the biotic and abiotic components of ecosystems, students begin to understand the important role that fire plays in ecosystem sustainability.

10. Wildland fire is a disturbance common to terrestrial ecosystems. It can alter the **composition, structure, and function** of biologic communities, influencing succession.
11. Fire has different effects on different ecosystems. The effect of wildland fire on an ecosystem is a function of timing, frequency, and **fire intensity**.
12. Some species have characteristics that help them survive **periodic fire**. Species adaptations to fire evolve in response to the characteristics of the fire regime in the ecosystem with which they are associated.

Theme 2: WHY IS WILDLAND FIRE IMPORTANT?

The concepts in this theme help students understand the connection between wildland fire and their own lives. Recognition of these connections helps to increase awareness of the importance of wildland fire management.

Wildland Fire and Society

By describing the interrelationship between wildland fire and human populations, students gain an understanding of the benefits and costs of wildland fire. Students form a basis for making decisions about wildland fire management.

13. Present conditions are a result of past events. Decisions about the use of prescribed fire and the suppression of wildland fire affect present and future society.
14. Throughout Wisconsin history, fire has been understood and used in different ways. Human use of fire is influenced by the state of knowledge, individual needs, and societal goals.
15. Wildland fires have led to loss of human life, property, and natural resources throughout Wisconsin's history (e.g., the Peshtigo, Phillips, and Marshfield fires). Destructive fires can cause changes in land use practices, community development trends, and local, state, and federal governance.
16. Wildland fire management has direct and indirect costs and benefits for the economy. Effective wildland fire management requires both financial and human resources.

Wildland Fire and the Environment

Rural ecosystems sustain human populations through the production of food and fiber and the provision of ecological services such as water retention, wildlife, and recreation. By defining the importance of fire in the rural landscape, students will be able to make connections between themselves, ecosystems, and current and historic fire management practices.

17. Throughout history, fire has played an influential role in determining the **composition**, **structure**, and **function** of many ecosystems. Terrestrial ecosystems in Wisconsin and the United States have been influenced by fire.
18. Fire can play an important role in the **restoration** and **maintenance** of ecosystems. In Wisconsin, periodic fire is an essential component of a variety of plant communities.
19. The management of ecosystems is influenced by our understanding of fire history. Understanding fire history can help land managers plan **prescribed fire**, **silvicultural prescriptions**, and **fire suppression** activities that help sustain ecosystems.

Theme 3: HOW DO WE MANAGE WILDLAND FIRE?

The concepts in this theme help students understand the role that humans play in the encouragement or elimination of fire from the landscape. For students to become participating members of a sustainable society, they must be able to understand the goals of different individuals and groups and empathize with people who have differing points of view. They must also have knowledge and skills to work together to ensure the ecological use of prescribed fire and to manage the threats that wildfire poses to human lives, property, and natural resources.

Definition of Wildland Fire Management

An understanding of the fundamentals of wildland fire management allows students to effectively participate in decision-making processes that affect the use and suppression of wildland fire.

20. Wildland fire management uses the principles of fire behavior and understanding of human fire practices to eliminate unwanted fires and promote beneficial ones. Wildland fire can be managed for cultural, ecological, and economic reasons.
21. Wildland fire management involves four interrelated activities: the **prevention** of accidental fire, **pre-suppression**, the **suppression** of unwanted fire, and the use of **prescribed fire** as a management tool.

Management Planning

By working together to come up with ideas on how to best manage wildland fire, students learn to empathize with others that have differing points of view, reach consensus, and outline practical solutions to real-life challenges.

22. Decisions about fire management involve land managers, property owners, communities, and governments. The needs of each group should be taken into consideration.
23. The economic, environmental, and social characteristics of the landscape are interrelated. The sustainable management of fire-dependant ecosystems requires that both human and ecological needs be met.
24. Fire management is achieved by setting objectives, developing a plan to meet the objectives, and implementing processes and activities in accordance with the plan.
25. Fire management plans must adapt to changing social, economic, and ecological conditions. Management strategies are limited by the resources available (e.g., skilled personnel, money, equipment).

Theme 4: WHAT IS THE FUTURE?

The concepts in this theme help students identify ways in which human populations can live compatibly with wildland fire. For students to make constructive decisions, they must have a clear understanding of their responsibility as citizens, the issues at hand, and the changes that may come.

Responsibility and Safety

By understanding the choices they can make to minimize the threat of wildland fire, students will be prepared to take actions that will decrease the occurrence of wildfire, the destruction that results, and ultimately influence the public perception of wildland fire.

26. Individuals have the responsibility to start and stop fires in safe and effective ways. Citizens who illegally start fire or carelessly allow a fire to escape may be penalized with fines and even imprisonment.
27. Homeowners have a responsibility to protect their property from wildland fire. The location, landscaping, maintenance, and design of a home can influence the threat of wildland fire to residents and their property.
28. **Community action plans** can help prevent wildland fire, facilitate the control of unwanted fire, and speed the recovery of communities after destructive wildland fire.
29. Fire management in Wisconsin and the United States involves a social agreement between the public and a variety of federal, state, municipal and private institutions.

Wildland Fire Issues

An understanding of the issues surrounding the use and suppression of wildland fire prepares students to make informed judgments on proposed management actions and land use plans and allows students to constructively participate in solution building processes.

30. Due to human land use and historical fire suppression, some of Wisconsin's fire-dependant plant communities (e.g., oak savannas, pine barrens, prairies) have been reduced in size. The continuation of these communities will require continued fire management.
31. Human population expansion and community development trends are causing the **fragmentation** of forest and grassland areas in Wisconsin. As the landscape becomes more fragmented, fire management becomes more difficult.
32. The **wildland-urban interface** is a condition where homes exist among wildland fuels. As people move into fire-prone areas, the potential for ignition of wildland fire increases and buildings and other man-made objects become a possible fuel source.
33. The use of some wildland fire management techniques (e.g., prescribed fire, construction of fire breaks, forest thinning) can be controversial because of safety issues and aesthetic impact. The current and past use of these techniques is sometimes misunderstood.

Advances in Wildland Fire Management

By analyzing trends in the study of wildland fire and related career opportunities, students better understand the efforts involved in wildland fire management and are able to prepare themselves for a future in related career fields.

34. The study of wildland fire is multidisciplinary. A complete understanding of wildland fire requires knowledge from a variety of disciplines such as physics, chemistry, biology, meteorology, ecology, economics, technology, politics, archeology, and history.
35. There are several natural resource career paths related to fire management including forest/range managers, fire suppression specialists, fire supervisors, fire prevention/education specialists, law enforcement officers, meteorologists, foresters, biologists, computer specialists, economists, and ecologists.
36. Science and technology contribute to the understanding of wildland fire, the impacts of human actions, and how fire can best be managed. As knowledge is gained, fire management is adapted.

Wildland Fire Definitions

Climate – The general weather conditions of a specified area over time.

Climate Change – The long-term fluctuations in precipitation, temperature, and wind caused mainly by variations in Earth's orbital rotations, volcanic activity, human land use practices, and the combustion of fossil fuels.

Community Action Plan – An agreement between members of a neighborhood or community to take action to reduce the risk of wildland fire ignition and help community members prepare for and recuperate from destructive wildland fire.

Composition – The species in a plant community.

Crown Fire – A fire that spreads across the tops of trees or shrubs.

Debris Burning – The outdoor burning of household and industrial rubbish; includes the legal burning of materials such as wood and paper, and the illegal burning of materials such as plastic and metal.

Detection – A system for discovering and locating wildland fires using patrols, fire towers, aerial detection, remote sensing, and public fire reporting.

Ecosystem – An area that contains organisms (e.g., plants, animals, bacteria) interacting with one another and their nonliving environment (e.g., climate, soil, topography).

Ecosystem Function – A function that makes it possible for life to exist; includes the fixation of energy, the cycling of matter, and the flow of energy through food webs.

Ecosystem Maintenance – The management of an ecosystem to sustain a desired composition and structure.

Ecosystem Restoration – The management of an ecosystem to achieve a composition and structure that existed under a historic disturbance regime.

Ecosystem Structure – The interrelationship between organisms and their environment.

Fire Behavior – The manner in which a fire reacts to its environment.

Fire Intensity – The amount of heat released per second as a wildland fire burns in a specified area; calculated by measuring the flame length, rate of spread, and heat per unit area.

Fire Regime – A cultural and biological system that defines the size, distribution, intensity, and frequency of fire in a given area.

Fire Triangle – The three elements (i.e., fuel, oxygen, heat) necessary for combustion to occur.

Fire Prevention – A variety of actions taken to decrease the risk of ignition of wildland fires; accomplished through education, engineering, and enforcement of laws.

Fire Response System – The organization of fire agencies, police, ambulance, hospital, and disaster relief to help extinguish fires, treat victims, rebuild communities, and identify the cause of the fire.

Fire Season – The periods of the year when wildland fires are likely to occur, spread, and threaten human lives, property, and natural resources; there are two main fire seasons in Wisconsin: Spring (April 1 to June 15) and Fall (September 1 to November 15)

Flame Length – The distance measured from the tip of the flame to the middle of the flaming zone at the base of the fire. It is measured on a slant when the flames are tilted due to effects of wind and slope.

Forest Structure – The vertical and horizontal layers in a forest.

Fragmentation – The process of dividing forested areas into smaller patches of forest and non-forest land.

Fuel – Any substance that contributes to the growth or spread of fire.

Fuel Characteristics – Properties of wildland fuel, including quantity, chemistry, compaction, continuity, moisture content, and size.

Ground Fire – A fire that burns the organic material in the soil layer, such as peat or duff.

Heat per Unit Area – The total amount of heat released from a square foot of fuel for the duration of combustion.

Land Cover – The features present across a landscape, such as forest, urban, and field.

Land Use – The human activities occurring across a landscape, such as forest management, land development, and agriculture.

Periodic Fire – The intermittent burning of an area caused by natural or human ignition.

Prediction – The estimation of the time and location of wildland fire ignition; achieved by monitoring fire conditions (i.e., fuel, weather) and major sources of ignition (i.e., human activity, lightning).

Prescribed Fire – To deliberately burn wildland fuels under specified conditions to meet desired management goals (e.g., fuel management, disease and pest control, wildlife habitat).

Pre-suppression – Activities undertaken to prepare for fire suppression; include the construction of access roads, preparation of suppression strategies, and training of suppression teams.

Rate of Spread – The speed (ft per min) at which a wildland fire moves into new fuels.

Silvicultural Prescription – A forestry activity (e.g., planting, harvesting, pruning, fertilizing) conducted to satisfy the objectives of a landowner; commonly used to promote the growth of valuable trees and protect forest stands from damaging agents such as wildland fire.

Species Introduction – The arrival and establishment of organisms that are not native to an ecosystem.

Species Extirpation – The extinction of a species from a given area.

Succession – The gradual change of one plant community to another.

Suppression – The act of confining and extinguishing a wildland fire.

Surface Fire – A fire that burns fuels on the forest floor such as leaf litter and small vegetation.

Topography – The relative elevation and configuration of features in a landscape.

Weather – The state of the atmosphere (i.e., temperature, moisture, wind) in a specified place at any given time.

Wildfire – A wildland fire that ignites and spreads without the intent and consent of the landowner.

Wildland Fire – An outdoor fire involving primarily vegetative fuels.

Wildland-Urban Interface – An area where human structures are in close proximity to wildland fuels.

SUGGESTED SCOPE AND SEQUENCE

Introduction

This section provides guidelines showing when and to what extent to integrate wildland fire education concepts into school curricula. LEAF developed this suggested scope and sequence with the help of K-12 teachers. The structure of the following section was developed based on *Wisconsin's Model Academic Standards* and the *Atlas of Science Literacy*. This section can be used as a guide for when (grade level) and where (subject area) forestry education concepts can be incorporated into a curriculum.

Note that this scope and sequence is not a one-size-fits-all solution to wildland fire education; educators and curriculum designers in each school system will need to determine the best ways to introduce concepts into their curricula. For example, after surveying existing curricula, educators may find that they are already addressing some of these concepts. If educators are not covering a particular concept, then they may revise curriculum to include it. The K-12 Wildland Fire Education Supplement will contain interdisciplinary activities that can be used by educators to bring wildland fire education concepts into their lessons.

Wisconsin Model Academic Standards

The Wisconsin Model Academic Standards were developed by the Wisconsin Department of Public Instruction. The standards specify what students should know and be able to do by certain points in their K-12 education. School districts may use the academic standards as guides for developing local grade-by-grade curricula. The subconcepts in this framework have been correlated with the standards to enhance ease of use for educators. The three subject areas cited (science, environmental education, and social studies) have the most direct correlation to the subconcepts. Certainly, other subject areas will be covered and listed in the K-12 Wildland Fire Education Supplement. Full text of the standards cited in the scope and sequence can be found in the appendix of this document.

How to use the following diagrams

All of the concepts and subconcepts have been placed on diagrams under the four theme headings. The purpose of this structure is to visually represent at which level (K-4, 5-8, 9-12) each of the subconcepts is introduced and how they spiral to higher grade levels. Some subconcepts are core ideas in forestry education that spiral through all levels. Other subconcepts enhance core ideas and may only appear at one or two levels. The levels chosen were based on *Bloom's Taxonomy of Cognitive Development* and correlated with the levels within Wisconsin's Model Academic Standards. The appropriate standards are listed at the end of the scope and sequence diagrams.

THEME 1 – WHAT IS WILDLAND FIRE?

	Definition of Wildland Fire	Fire Behavior	Fire Regimes	Fire Ecology
K-4	<p>1. In Wisconsin, there are two main types of wildland fire: wildfire and prescribed fire. Wildfires start without the intent of the landowner or land manager and are unwanted. Prescribed fires are planned and controlled to meet the goals of a landowner or land manager.</p> <p>2. The ignition of wildland fire can be caused by human activity (e.g., debris burning and other outdoor burning, machine sparks, children playing with matches, power lines, fireworks) or natural sources (e.g., lightning, spontaneous combustion). Human activity is responsible for most wildland fires in Wisconsin.</p>	<p>3. To exist, fire requires oxygen, heat, and fuel – collectively known as the fire triangle. Under most conditions, the three factors can be manipulated to slow or stop the spread of fire.</p> <p>6. The three basic types of fire behavior are named according to the vegetation layer in which the fire is burning: ground fire, surface fire, and crown fire. Wildland fire can be further characterized by the rate of spread, flame length, and heat per unit area.</p>	<p>7. Humans are a fundamental component of ecosystems. The Earth's fire regimes have been shaped by human influences.</p> <p>8. Regions in Wisconsin and the US differ in climate, topography, land cover, and land use. These differences create distinct fire regimes.</p>	
5-8	<p>1. In Wisconsin, there are two...</p> <p>2. The ignition of wildland fire ...</p>	<p>4. Scientific principles that describe the transfer and transformation of energy help us understand and predict fire behavior.</p> <p>5. Fire behavior is influenced by topography, weather, and fuel characteristics. The fire season is determined by seasonal changes in weather and fuel.</p> <p>6. The three basic types of fire behavior are...</p>	<p>7. Humans are a fundamental...</p> <p>8. Regions in Wisconsin and the US differ...</p> <p>9. Fire regimes change through time due to factors such as forest succession, human activity, climate change, species introduction, and species extirpation.</p>	<p>10. Wildland fire is a disturbance common to terrestrial ecosystems. It can alter the composition, structure, and function of biologic communities, influencing succession.</p> <p>11. Fire has different effects on different ecosystems. The effect of wildland fire on an ecosystem is a function of timing, frequency, and fire intensity.</p> <p>12. Some species have characteristics that help them survive periodic fire. Species adaptations to fire evolve in response to the characteristics of the fire regime in the ecosystem with which they are associated.</p>
9-12		<p>4. Scientific principles that describe...</p> <p>5. Fire behavior is influenced...</p> <p>6. The three basic types of fire behavior...</p>	<p>7. Humans are a fundamental...</p> <p>9. Fire regimes change through time...</p>	<p>10. Wildland fire is a disturbance...</p> <p>11. Fire has different effects on different ecosystems...</p> <p>12. Some species have characteristics that help them survive periodic fire...</p>

THEME 2 – WHY IS WILDLAND FIRE IMPORTANT?

	Wildland Fire and Society	Wildland Fire and the Environment
K-4	<p>13. Present conditions are a result of past events. Decisions about the use of prescribed fire and the suppression of wildland fire affect present and future society.</p> <p>14. Throughout Wisconsin history, fire has been understood and used in different ways. Human use of fire is influenced by the state of knowledge, individual needs, and societal goals.</p> <p>15. Wildland fires have led to loss of human life, property, and natural resources throughout Wisconsin's history (e.g., the Peshtigo, Phillips, and Marshfield fires). Destructive fires can cause changes in land use practices, community development trends, and local, state, and federal governance.</p> <p>16. Wildland fire management has direct and indirect costs and benefits for the economy. Effective wildland fire management requires both financial and human resources.</p>	
5-8	<p>13. Present conditions are a result of past events...</p> <p>14. Throughout Wisconsin history, fire has been understood and used in different ways...</p> <p>15. Wildland fires have led to loss of human life, property, and natural resources...</p> <p>16. Wildland fire management has direct and indirect costs and benefits for the economy...</p>	<p>17. Throughout history, fire has played an influential role in determining the composition, structure, and function of many ecosystems. Terrestrial ecosystems in Wisconsin and the United States have been influenced by fire.</p> <p>18. Fire can play an important role in the restoration and maintenance of ecosystems. In Wisconsin, periodic fire is an essential component of a variety of plant communities.</p>
9-12	<p>13. Present conditions are a result of past events...</p> <p>16. Wildland fire management has direct and indirect costs and benefits for the economy...</p>	<p>17. Throughout history, fire has played an influential role...</p> <p>18. Fire can play an important role in the restoration and maintenance of ecosystems...</p> <p>19. The management of ecosystems is influenced by our understanding of fire history. An understanding of fire history can help land managers plan prescribed fire, silvicultural prescriptions, and fire suppression activities that help sustain ecosystems.</p>

THEME 3 – HOW DO WE MANAGE WILDLAND FIRE?

	Definition of Wildland Fire Management	Management Planning
K-4	<p>20. Wildland fire management uses the principles of fire behavior and understanding of human fire practices to eliminate unwanted fires and promote beneficial ones. Wildland fire can be managed for cultural, ecological, and economic reasons.</p>	<p>22. Decisions about fire management involve land managers, property owners, communities, and governments. The needs of each group should be taken into consideration.</p> <p>23. The economic, environmental, and social characteristics of the landscape are interrelated. The sustainable management of fire-dependant ecosystems requires that both human and ecological needs be met.</p>
5-8	<p>20. Wildland fire management uses the principles of...</p> <p>21. Wildland fire management involves four interrelated activities: the prevention of accidental fire, pre-suppression, the suppression of unwanted fire, and the use of prescribed fire as a management tool.</p>	<p>22. Decisions about fire management involve...</p> <p>23. The economic, environmental, and social characteristics of the landscape are interrelated...</p>
9-12	<p>20. Wildland fire management uses the principles of...</p> <p>21. Wildland fire management involves four interrelated activities: the prevention of accidental fire, pre-suppression, the suppression of unwanted fire, and the use of prescribed fire as a management tool.</p>	<p>22. Decisions about fire management involve...</p> <p>23. The economic, environmental, and social characteristics of the landscape are interrelated...</p> <p>24. Fire management is achieved by setting objectives, developing a plan to meet the objectives, and implementing processes and activities in accordance with the plan.</p> <p>25. Fire management plans must adapt to changing social, economic, and ecological conditions. Management strategies are limited by the resources available (e.g., skilled personnel, money, equipment).</p>

THEME 4 – WHAT IS THE FUTURE OF WILDLAND FIRE?

	Responsibility and Safety	Wildland Fire Issues	Advances in Wildland Fire Management
K-4	<p>26. Individuals have the responsibility to start and stop fires in safe and effective ways. Citizens who illegally start fire or carelessly allow a fire to escape may be penalized with fines and even imprisonment.</p> <p>27. Homeowners have a responsibility to protect their property from wildland fire. The location, landscaping, maintenance, and design of a home can influence the threat of wildland fire to residents and their property.</p> <p>28. Community action plans can help prevent wildland fire, facilitate the control of unwanted fire, and speed the recovery of communities after destructive wildland fire.</p>		<p>34. The study of wildland fire is multidisciplinary. A complete understanding of wildland fire requires an understanding of disciplines such as physics, chemistry, biology, meteorology, ecology, economics, technology, politics, archeology, and history.</p> <p>35. There are several natural resource career paths related to fire management, including forest/range managers, fire suppression specialists, fire supervisors, fire prevention/education specialists, law enforcement officers, meteorologists, foresters, biologists, computer specialists, economists and ecologists.</p>
5-8	<p>26. Individuals have the responsibility to start and stop fires...</p> <p>27. Homeowners have a responsibility to protect their property ...</p> <p>28. Community action plans can help prevent wildland fire...</p>	<p>30. Due to human land use and historical fire suppression, some of Wisconsin's fire-dependant plant communities (e.g., oak savannas, pine barrens, prairies) have been reduced in size. The continuation of these communities will require continued fire management.</p> <p>31. Human population expansion and community development trends are causing the fragmentation of forest and grassland areas in Wisconsin. As the landscape becomes more fragmented, fire management becomes more difficult.</p>	<p>34. The study of wildland fire is multidisciplinary...</p> <p>35. There are several natural resource career paths related to fire management...</p> <p>36. Science and technology contribute to the understanding of wildland fire, the impacts of human actions, and how fire can best be managed. As knowledge is gained, fire management is adapted.</p>
9-12	<p>27. Homeowners have a responsibility to protect their property...</p> <p>28. Community action plans can help prevent wildland fire...</p> <p>29. Fire management in Wisconsin and the United States involves a social agreement between the public and a variety of federal, state, municipal and private institutions.</p>	<p>30. Due to human land use and historical fire suppression...</p> <p>31. Human population expansion and community development trends...</p> <p>32. The wildland-urban interface is a condition where homes exist among wildland fuels. As people move into fire-prone areas, the potential for ignition of wildland fire increases and buildings and other man-made objects become a possible fuel source.</p> <p>33. The use of some wildland fire management techniques (e.g., prescribed fire, construction of fire breaks, forest thinning) can be controversial because of safety issues and aesthetic impact. The current and past use of these techniques is sometimes misunderstood.</p>	<p>34. The study of wildland fire is multidisciplinary...</p> <p>35. There are several natural resource career paths related to fire management...</p> <p>36. Science and technology contribute...</p>

Wisconsin Model Academic Standards

THEME 1: WHAT IS WILDLAND FIRE?

K-4

Environmental Education

B.4.6 – Cite examples of how different organisms adapt to their habitat.

Science

D.4.2 – Group and/or classify objects or substances based on properties of earth materials

D.4.4 – Observe and describe changes in form, temperature, color, speed, and directions of objects and construct explanations for the changes.

E.4.5 – Describe the weather commonly found in Wisconsin in terms of clouds, temperature, humidity, and forms of precipitation, and the changes that occur over time, including seasonal changes.

E.4.6 – Using the science themes, find patterns and cycles in the earth’s daily, yearly, and long-term changes.

F.4.4 – Using the science themes, develop explanations for the connections among living and nonliving things in various environments.

Social Studies

A.4.4 – Describe and give examples of ways in which people interact with the physical environment, including use of land, locations of communities, methods of construction, and design of shelters.

5-8

Environmental Education

B.8.1 – Describe the flow of energy in a natural and a human-built ecosystem using the laws of thermodynamics.

B.8.2 – Explain how change is a natural process, citing examples of succession, evolution, and extinction.

B.8.10 – Explain and cite examples of how humans shape the environment.

Science

D.8.9 – Explain the behaviors of various forms of energy by using the models of energy transmission, both in the laboratory and in real-life situations.

E.8.1 – Using the science themes, explain and predict changes in major features of land, water, and atmospheric systems.

E.8.3 – Using the science themes during investigation, describe climate, weather, ocean currents, soil movements, and changes in the forces acting on the earth.

F.8.2 – Show how organisms have adapted structures to match their functions, providing means of encouraging individual and group survival within specific environments.

F.8.7 – Understand that an organism’s behavior evolves through adaptation to its environment.

Social Studies

A.8.4 – Conduct a historical study to analyze the use of the local environment in a Wisconsin community and to explain the effect of this use on the environment.

9-12

Environmental Education

B.12.3 – Evaluate the stability and sustainability of ecosystems in response to changes in environmental conditions.

B.12.8 – Relate the impact of human activities in ecosystems to the natural process of change, citing examples of succession, evolution, and extinction.

Science

D.12.11 – Using the science themes, explain common occurrences in the physical world.

F.12.8 – Using the science themes, infer changes in ecosystems prompted by the introduction of new species, environmental conditions, chemicals, and air, water, or earth pollution.

THEME 2: WHY IS WILDLAND FIRE IMPORTANT?

K-4

Social Studies

A.4.4 – Describe and give examples of ways in which people interact with the physical environment, including use of land, locations of communities, methods of construction, and design of shelters.

B.4.4 – Compare and contrast changes in contemporary life with life in the past by looking at social, economic, political, and cultural roles played by individuals and groups.

D.4.2 – Identify situations requiring an allocation of limited economic resources and appraise the opportunity cost.

D.4.6 – Identify the economic roles of various institutions, including households, businesses, and government.

5-8

Environmental Education

B.8.2 – Explain how change is a natural process, citing examples of succession, evolution, and extinction.

B.8.9 – Explain how the environment is perceived differently by various cultures.

B.8.10 – Explain and cite examples of how humans shape the environment.

Science

F.8.9 – Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or populations growth of certain species.

Social Studies

A.8.4 – Conduct a historical study to analyze the use of the local environment in a Wisconsin community and to explain the effect of this use on the environment.

9-12

Environmental Education

B.12.3 – Evaluate the stability and sustainability of ecosystems in response to changes in environmental conditions.

THEME 3: HOW DO WE MANAGE WILDLAND FIRE?

5-8

Environmental Education

B.8.16 – Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted.

B.8.23 – Identify governmental and private agencies responsible for environmental protection and natural resource management.

B.8.16 – Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted.

Science

H.8.2 – Present a scientific solution to a problem involving the earth and space, life and environmental, or physical sciences and participate in a consensus-building discussion to arrive at a group decision.

Social Studies

A.8.11 – Give examples of the causes and consequences of current global issues, such as the expansion of global markets, the urbanization of the developing world, the consumption of natural resources, and the extinction of species, and suggest possible responses by various individuals, groups, and nations.

B.8.10 – Analyze examples of conflict, cooperation, and interdependence among groups, societies, and nations.

9-12

Environmental Education

B.12.2 – Describe the value of ecosystems from a natural and human perspective; e.g., food, shelter, flood control, water purification.

B.12.10 – Identify and evaluate multiple uses of natural resources and how society is influenced by the availability of these resources.

B.12.12 – Evaluate the environmental and societal costs and benefits of allocating resource in various ways and identify management strategies to maintain economic and environmental sustainability.

C.12.1 – Compare the effects of natural and human-caused activities that either contribute to or challenge an ecologically and economically sustainable environment.

Science

A.12.5 – Show how the ideas and themes of science can be used to make real-life decisions about careers, work places, life-styles, and use of resources.

H.12.3 – Show how policy decisions in science depend on many factors, including social values, ethics, beliefs, time-frames, and considerations of science and technology.

Social Studies

A.12.12 – Assess the advantages and disadvantages of selected land use policies in the local community, Wisconsin, the United States, and the world.

B.12.15 – Identify the skills needed to work effectively alone, in groups, and in institutions.

THEME 4: WHAT IS THE FUTURE?

K-4

Science

H.4.4 – Develop a list of issues that citizens must make decision about and describe a strategy for becoming informed about the science behind these issues.

G.4.1 – Identify the technology used by someone employed in a job or position in Wisconsin and explain how the technology helps.

Social Studies

A.4.4 – Describe and give examples of ways in which people interact with the physical environment, including use of land, locations of communities, methods of construction, and design of shelters.

A.4.9 – Give examples to show how scientific and technological knowledge has led to environmental changes, such as pollutions prevention measures, air-condition, and solar heating.

C.4.5 – Explain how various forms of civic actions such as running for political office, voting, signing an initiative, and speaking at hearings, can contribute to the well-being of the community.

5-8

Environmental Education

B.8.10 – Explain and cite examples of how humans shape the environment.

B.8.22 – Identify careers related to natural resources and environmental concerns.

B.8.23 – Identify governmental and private agencies responsible for environmental protection and natural resource management.

Science

F.8.9 – Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or populations growth of certain species.

F.8.10 – Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.

G.8.1 – Identify and investigate the skills people need for a career in science or technology and identify the academic courses that a person pursuing such a career would need.

G.8.2 – Explain how current scientific and technological discoveries have an influence on the work people do and how some of these discoveries also lead to new careers.

Social Studies

A.8.10 – Identify major discoveries in science and technology and describe their social and economic effects on the physical and human environment.

A.8.11 – Give examples of the causes and consequences of current global issues, such as the expansion of global markets, the urbanization of the developing world, the consumption of natural resources, and the extinction of species, and suggest possible responses by various individuals, groups, and nations.

B.8.8 – Identify major scientific discoveries and technological innovations and describe their social and economic effects on society.

B.8.10 – Analyze examples of conflict, cooperation, and interdependence among groups, societies, and nations.

E.8.4 – Describe and explain the means by which individuals, groups, and institutions may contribute to social continuity and change within a community.

9-12

Environmental Education

B.12.3 – Evaluate the stability and sustainability of ecosystems in response to changes in environmental conditions.

B.12.9 – Evaluate ways in which technology has expanded our ability to alter the environment and its capacity to support humans and other living organisms.

B.12.14 – Investigate how technological development has influenced human relationships and understanding of the environment.

B.12.21 – Research the roles of various careers related to natural resource management and other environmental fields.

Science

B.12.4 – Show how basic research and applied research contribute to new discoveries, inventions, and applications.

G.12.4 – Show how a major scientific or technological change has had an impact on work, leisure, or the home.

Social Studies

A.12.9 – Identify and analyze cultural factors, such as human needs, values, ideals, and public policies, that influence the design of places, such as an urban center, an industrial park, a public project, or a planned neighborhood.

A.12.12 – Assess the advantages and disadvantages of selected land use policies in the local community, Wisconsin, the United States, and the world.

C.12.10 – Identify ways people may participate effectively in community affairs and the political process.

REFERENCES

- Brown, A. B. and Davis, K. P. (1973). Forest Fire: Control and Use, 2nd Ed. McGraw-Hill Book Company. New York, New York.
- Chandler, C. et al. (1983). Fire in Forestry, Volumes 1 and 2. John Wiley and Sons, Inc. New York, New York.
- Erickson, H. L. (1998). Concept-Based Curriculum and Instruction: Teaching Beyond the Facts. California: Corwin Press, Inc.
- Helms, J. A., (Ed.). (1998). The Dictionary of Forestry. Maryland: Society of American Foresters.
- K-12 Energy Education Program—A Conceptual Guide to K-12 Energy Education in Wisconsin. (1999). Wisconsin: Energy Center of Wisconsin and Wisconsin Center for Environmental Education.
- Mullins, G. W. ed. (2001). Communicator's Guide: Wildland Fire. Ohio State University Printing Services.
- National Wildfire Coordinating Group. (1996). Wildfire Prevention: Conducting School Programs Guide. PMS 453. NFES1254. National Interagency Fire Center. Boise, Idaho.
- National Wildfire Coordinating Group. (1999). Fire Communication and Education. PMS 458. NFES 2602. National Interagency Fire Center. Boise, Idaho.
- Owen, J. and Durland, P. (2002). Wildland Fire Primer: A Guide for Educators. U.S. Department of the Interior Bureau of Land Management. National Interagency Fire Center. Boise, Idaho.
- Pyne, S. J. (1982). Fire in America: A Cultural History of Wildland and Rural Fire. Princeton University Press. Princeton, New Jersey.
- Pyne, S. J., Andrews, P. L., and Laven, R. D. (1996). Introduction to Wildland Fire. John Wiley and Sons, Inc. New York, New York.
- Vale, T. R. (2002). Fire, Native Peoples, and the Natural Landscape. Island Press. Washington, D.C.
- Wisconsin K-12 Forestry Education Program – A Conceptual Guide to K-12 Forestry Education in Wisconsin. (2002). Wisconsin Center for Environmental Education and the Wisconsin Department of Natural Resources – Division of Forestry.