

Subject: Forestry and Wildlife

Unit 1: Wildlife

Grade Level: 10-12

Designed by: Kevin Hilsey

School District: Tunkhannock Area School District

School: Tunkhannock High School

Brief Summary of Unit:

The primary focus of this unit is the physical characteristics, behaviors, reproduction, and ecology of native Pennsylvania animals.

Through the use of handouts, videos, discussion, models and preserved specimens the students will:

- Explain the natural history and reproductive patterns of select groups of Pennsylvania animals. Sections will include: White-tailed deer; Black Bear; Canidae and Felidae Families; Game Birds; Birds of Prey; Reptiles and Amphibians;

Possible extension activities for accelerated students:

- Students will be able to compare and contrast biological carrying capacity and cultural carrying capacity of white-tailed deer and Black Bear
- Students will research current Pennsylvania Game Commission regulations regarding Black Bear and White-tailed Deer management and analyze the historical and current effectiveness of the regulations as they relate to each game animal.
- Investigate and summarize the scientific evidence for the presence of the Cougar in Pennsylvania.
- Small mammal research projects can be assigned as well as further bird research into passerine birds.

Differentiation for the non-advanced students:

- Some students may need additional, individualized instruction which may require adapted reading materials.
- Students will complete posters, diorama, or PowerPoint projects which visually demonstrate understanding of the topics.
- Drawings of deer with the number of offspring, bear and other animals with their offspring and den sites will help the students remember these reproduction facts.

Unit 1: Wildlife

Section 1: White-tailed Deer

3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms
3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.
4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.
3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

Overarching Understandings

- White tailed deer are a ruminant animal in the family Cervidae.
- White-tailed deer are a keystone herbivore in Pennsylvania forests and the most widespread large animal in the United States.

Topical Understandings	Essential Questions
<ul style="list-style-type: none">• Explain the natural history and reproductive patterns of the white-tailed deer.• List the favorite foods and most ideal habitat of the white-tailed deer.• Trace the history of the white-tailed deer in Pennsylvania and relate environmental changes to historical events which caused their numbers to increase to present levels.• Students will be able to list positive impacts of white-tailed deer on their habitat and and negative impacts on their habitat and to humans.• Students will be able to relate different types of habitat to the maximum sustainable densities of deer that each will support.• Students will be able to explain current white-tailed deer management practices in their local area..	<ul style="list-style-type: none">• What characteristics place White-tailed deer in the Cervidae family?• What role do pheromones play in deer behavior?• Why do deer spend much of their time bedded down?• Which type of forest habitat can support the most deer?• Which food is primarily responsible for sustaining White-tailed Deer in the winter?• How do deer food preferences change with the seasons?• How many fawns are the most common for doe to have? When are the fawns born? and when do most doe get pregnant?• How are antlers related to the age and diet of bucks?• What are the current hunting regulations relating to White-tailed Deer in Pennsylvania?
Knowledge	Skills
<ul style="list-style-type: none">• Vocabulary: fawn, buck, doe, rub, scrape, vomeronasal, Flehmen gesture or Flehmen response, pheromones, rut, tarsal, rack, antler, point, tine, hock, chronic wasting disease, gestation, testosterone, ruminant, cud, browser, grazer, crepuscular, herbivore, prion, interdigital, home range Pennsylvania Game Commission, Wildlife Management Unit (WMU)	<ul style="list-style-type: none">• Explain the feeding habits of White-tailed deer at various seasons of the year• Explain how hormonal changes effect deer social groupings and behavior• Discuss various deer scent glands and how they affect deer behavior• Describe how white-tailed deer are managed.• Describe White-tailed deer reproduction.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Deer Exam	<ul style="list-style-type: none">• 70% or better shows evidence of understanding• Worksheets from the handout and video can also be graded to show competency

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• <u>White-tailed Deer</u> handout (from the <u>Wildlife Notes</u> Series-Pennsylvania Game Commission, by Chuck Fergus)• Vhs tape: <u>White-tailed Deer, Living with Change</u>• Chronic Wasting Disease handout• Deer scent glands handout	<ul style="list-style-type: none">• Students read handout aloud or silently depending on the reading level of the group, then teacher highlights important facts to know.• Video worksheet is given out prior to showing the video. The questions run chronologically with the video and students fill in answers as it plays. Teacher stops video periodically to allow students to check their answers with lab partners.• Other handouts are read aloud and teacher clarifies the main ideas and asks students to highlight these facts.

Unit 1: Wildlife

Section 2: Black Bear

- 3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms
- 3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.
- 4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.
- 3.1.10.A3:** Compare and contrast the **life cycles** of different **organisms**.

<p>Overarching Understandings</p> <ul style="list-style-type: none"> • Black Bear are the world's most common bear species and one of the least aggressive species in the family Ursidae.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Although they are classified in the order Carnivora, Black Bears are omnivorous animals who rarely hunt down prey. • Black Bears eat more plants than meat and find most of their food by scent. • Food availability often determines the timing of when Black Bears begin their winter dormancy period. 	<ul style="list-style-type: none"> • How does the Black Bear compare to other bears in North America in terms of diet, habitat requirements and aggressiveness? • Where do Black Bears den? • What is delayed implantation? • How does winter dormancy compare to hibernation? • What is the approximate carrying capacity of Black Bears in Pennsylvania?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: boar, cub, sow, delayed implantation, den, omnivore, Pre-molar, carrying capacity, hibernation, winter sleep or winter dormancy, nocturnal, Ursidae 	<ul style="list-style-type: none"> • Describe Black Bear senses and how they relate to feeding behavior. • Contrast hibernation with “winter dormancy” or “winter sleep” • Describe the variety of Black Bear den sites and differences between male and female den sites. • Describe Black Bear reproduction • List the favorite foods and habitat requirements of the Black Bear.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none"> • Black Bear Exam 	<ul style="list-style-type: none"> • 70% or better on exam shows evidence of understanding, as well as accuracy completing assigned video and reading worksheets. • Oral answers to questions during Bear feeding activity- <u>Too Many Bears</u>

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Black Bear handout (from the <u>Wildlife Notes</u> Series of the Pennsylvania Game Commission, by Chuck Fergus)• <u>Pennsylvania Black Bear</u> vhs tape and accompanying question sheet.• <u>Too Many Bears</u> (Black Bear feeding activity, along with food cards, envelopes and teacher's guide, bandana for a blindfold,	<ul style="list-style-type: none">• Teacher will use the handout and the video as the main instructional tools.• Students will fill out a worksheet on the video and will highlight the key facts that the teacher notes as most important in their packets.• Teacher will use the Too Many Bears activity to teach about the concepts of carrying capacity and competition for resources. After playing the game outside or in the hallway, the students will return to their room, add up their food and then this will lead into a lecture and discussion about carrying capacity and competition.

3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms

3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.

4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.

3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

<p>Overarching Understandings</p> <ul style="list-style-type: none"> • Birds are members of the Class Aves. • Characteristics of modern birds in the Class Aves are: forelimbs modified into wings, 2 feet adapted to a specific habitat, body covered with feathers, a beak (without teeth) adapted to a particular food source, endothermic, oviparous, most can fly.
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Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • This section of the wildlife unit will begin by introducing the classification of birds and describing the specific characteristics of class Aves and which characteristics separate birds from other animal classes. • Characteristics of a few select orders of birds will be introduced- Piciformes, Galliformes, Strigiformes, Falconiformes and Passeriformes. • Pennsylvania members of the order Galliformes will be covered in detail, with particular emphasis on the “big three”- Wild Turkey, Ring-necked Pheasant and Ruffed Grouse. • Game birds are members of the order Galliformes • Pennsylvania’s state bird is the Ruffed Grouse. 	<ul style="list-style-type: none"> • How are birds different from other animals? • Why do bird beaks come in different shapes and sizes? • What characteristics separate game birds from other orders of birds? • What is Pennsylvania’s state bird? • What is our largest game bird? • Which game bird drums to call its mate? • Which game bird is the most solitary? • What does precocial mean and why are game birds precocial?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: Galliformes, precocious, altricial, spur, caruncle, beard, snood, primary feather, tail feather, brooding, poult, ectothermic, endothermic, clutch, cock, tom, hen, incubation, native, introduced, endemic, oviparous. 	<ul style="list-style-type: none"> • Explain adaptations of the Galliformes order. • Describe the differences between the different bird orders. • Explain the differences between precocial and altricial birds and describe why game birds are precocial. • Describe the feeding habits of the different game birds.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Game Bird Review Sheet• Game Bird Exam	<ul style="list-style-type: none">• Review sheet will be completed for homework and will be given a homework grade. Teacher will then go over, and students will correct their answers and use as a study guide.• 70% or better on quiz will demonstrate evidence of understanding.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Teacher-made notes on bird characteristics, bird orders, a “Bird Brain” quiz, and a Game Bird review sheet and Game Bird quiz• <u>Handouts</u> from the <u>Wildlife Notes Series</u>- Wild Turkey, Ruffed Grouse, Pheasant• <u>Wild Turkey</u> dvd from the Wild America series by Marty Stauffer• Mounted specimens of Wild Turkey, Ruffed Grouse and Ring-necked Pheasant• Primary and Tail feather specimens from turkey• Various specimens of turkey and chicken feet• Bird Sounds CD- turkey calls, grouse drumming and Pheasant calls	<ul style="list-style-type: none">• Bird Brain quiz will be given at the beginning of the unit as an introduction.• Teacher-made notes will be projected and students will copy notes throughout the unit.• Students read handout aloud or silently depending on the reading level of the group, then teacher highlights the important facts to know.• Video is shown and the teacher discusses important information that is new and students take notes.• Other handouts are read aloud and teacher will highlight and clarify important points.

- 3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms
- 3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.
- 4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.
- 3.1.10.A3:** Compare and contrast the **life cycles** of different **organisms**.

<p>Overarching Understandings</p> <ul style="list-style-type: none"> • The term Birds of Prey, refers to diurnal raptors (Eagles, Hawk and Falcons) as well as nocturnal raptors (Owls) and also vultures, kites and others. • “Bird of Prey” is not a specific taxon. It refers to a grouping of birds that are adapted for predation or scavenging.
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Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Birds of Prey have many adaptations for sensing and catching prey including excellent binocular vision, hearing, and claws and beaks adapted to catching and holding prey. • The word “raptor” is a synonym for “bird of prey”. • Hawks is a term for diurnal raptors and includes Eagles, Osprey and 11 species in Pennsylvania. 	<ul style="list-style-type: none"> • What adaptations do raptors have that make them such efficient hunters? • What are the physical differences between buteos and an accipiters? • How did DDT affect raptors and why did it particularly affect Eagles and Osprey? • What adaptations do falcons have for high speed flight?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: raptor, cere, rod, cone, accipiter, buteo, harrier, falcon, eyrie, stoop, nictitating membrane, mantling, kettle, ddt, rods, cones, kiting, mobbing 	<ul style="list-style-type: none"> • Describe the “stoop” of the Peregrine falcon • Explain the adaptations that raptors have for catching and holding prey. • Describe the bodies of accipiters and buteos and list what their preferred prey items are. • List 3 Pennsylvania falcons and 3 Pennsylvania hawks and describe the characteristics of each

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Exam of Birds of Prey• <u>Nature: Birds of Prey</u> dvd worksheet can be used to assess understanding of falcon adaptations.	<ul style="list-style-type: none">• 70% score on exam will show evidence of competency• 70% or better score on worksheet

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Handouts from the <u>Wildlife Notes</u> Series-• <u>Nature: Birds of Prey</u> dvd and worksheet• <u>Raptors</u>- vhs tape• <u>Owls</u>- vhs tape• <u>Bird Sounds CD</u>- Red-tailed hawk, Bald Eagle• Owl pellet kits (available from Science in Motion through Wilkes University, or by pre-order from most Science catalogs)	<ul style="list-style-type: none">• Students read handout aloud or silently depending on the reading level of the group, then teacher highlights the important facts to know.• Video is shown and the teacher discusses important information that is new and students take notes.• Other handouts are read aloud, teacher clarifies important points and students highlight their handout or take notes in notebook.

Unit 1: Wildlife

Section 5: Canidae and Felidae families

3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms

3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.

4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.

Analyze the differences between natural causes and human causes of **extinction**.

3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

<p>Overarching Understandings</p> <ul style="list-style-type: none"> The Canidae and Felidae families are included in the order Carnivora. These are the state's large predatory "dogs" and "cats"
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Topical Understandings	Essential Questions
<ul style="list-style-type: none"> Members of the Canidae family include foxes, coyotes, wolves and domesticated dogs. The mountain lion (aka cougar or puma) is the largest member of the Felidae family in the U.S., but has been extirpated from Pennsylvania. The bobcat is the only wild member of the Felidae family found in PA. It is closely related to the Canada Lynx and their territories overlap in some states and in Canada. 	<ul style="list-style-type: none"> What are the two kinds of foxes found in PA? What are the differences between the two types of foxes in PA? How does breeding behavior differ between Canids and Felids? What are some of the adaptations that make Canidae and Felidae efficient predators When is the Bobcat's prime hunting times? What is the origin (genetically and geographically) of the Eastern Coyote? Should the PA Game Commission pay bounties on coyotes?
Knowledge	Skills
<ul style="list-style-type: none"> Vocabulary: canid, felid, Canidae, Felidae, vixen, dog, bitch, pup, kit, extinct, extirpated, endangered, cache, regurgitate, wean, 	<ul style="list-style-type: none"> Compare and contrast the two species of foxes living in PA Compare the social grouping and reproductive behavior of Canids and Felids. Compare and contrast the Lynx and the Bobcat Describe the origin (genetically and geographically) of the Eastern Coyote

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Combined Exam on Canidae and Felidae families	<ul style="list-style-type: none">• 70% score on exam will show competency.• Worksheets from all handouts can also be graded together or separately, as well as the video sheet from <u>In the Valley of the Wolves</u>.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Powerpoint presentation which includes select members of Canidae and Felidae families• Handouts from the <u>Wildlife Notes Series- Foxes, Coyote, Bobcat</u>• Dvd- <u>Nature: In the Valley of the Wolves</u>• Student video worksheet• Pelts of red fox, gray fox	<ul style="list-style-type: none">• Powerpoint presentation used to introduce this section. Students take notes.• Students read handouts aloud or silently depending on the reading level of the group, then teacher highlights the important facts to know. Students either take notes or highlight their handouts.• Video worksheet is given out prior to showing the video. The questions do not run chronologically with the video. Teacher stops video periodically to allow students to check their answers with lab partners• Other handouts are read aloud and teacher highlights and clarifies important points.

Unit 1: Wildlife

Section 6: Amphibians and Reptiles

- 3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms
- 3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.
- 4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**.
- 3.1.10.A3:** Compare and contrast the **life cycles** of different **organisms**.

Overarching Understandings

- Amphibians and Reptiles are animals that are often confused but represent two distinct classes of ectothermic animals. This section of the course will explore the most common amphibians and reptiles found in PA, their similarities and differences.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Amphibians are a class of animals that have some members adapted to terrestrial life, but most require aquatic environments for the larval stage of their life cycle. • Most amphibian life cycles involve complete metamorphosis with 3 distinct stages- egg, larva and adult. • The two most common orders of amphibians in PA are the Anura- frogs and Caudata- salamanders. • Reptiles have more advanced breathing, locomotion, eggs and other features that make them more adapted to terrestrial environments than amphibians. • Most reptiles do not require aquatic environments to reproduce because they produce an amniotic egg. 	<ul style="list-style-type: none"> • What does the word amphibian mean? • What are the characteristics of an amphibian? • What are the two main orders of amphibians found in PA? • What are the characteristics of a reptile? • What are the 2 main groups of reptiles found in PA? • Why are reptiles better adapted to living on land than amphibians? • What are Pennsylvania's 3 venomous snakes? What family are they in? • What characteristics distinguish venomous snakes from non-venomous?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: metamorphosis, paedomorphosis, incomplete metamorphosis, tympanum, amplexus, parotid gland, regeneration, hibernation, Caudata, Anura, bridge, carapace, plastron, scute, amniotic, tetrapod, vernal pool, newt, skink, Colubridae, Elapidae, viper, Jacobson's organ, pit viper, external 	<ul style="list-style-type: none"> • Explain the differences between amphibians and reptiles • Explain the differences between the order Anura and the order Caudata • Describe the most common salamanders, frogs, snakes and turtles found in Pennsylvania and what their habitat requirements are.

fertilization, larvae, spermatophore, cloaca, terrestrial, aquatic, nares,	<ul style="list-style-type: none"> List the poisonous snakes in Pennsylvania. Describe the poisonous snakes in PA.
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Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none"> Reptile and Amphibian Exam 	<ul style="list-style-type: none"> 70% or better score on exam shows evidence of understanding.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none"> Powerpoint presentation on Amphibians and one on Reptiles Handouts: <u>Beautiful Bufo, Hoppers and Leapers, Snakes of Pennsylvania</u> Picture charts of PA amphibians and reptiles <u>Amphibians and Reptiles</u> from the <u>Life</u> dvd series Wood Turtle shells Live turtles and frogs from school pond, if it is not Winter. <u>Frog Sounds</u> cd- bullfrog, green frog, spring peeper, leopard frog, 	<ul style="list-style-type: none"> Powerpoint presentation used to introduce this section. Students take notes. Students read handouts aloud or silently depending on the reading level of the group, then teacher highlights the important facts to know. Students either take notes or highlight their handouts. Picture charts are show in the beginning and throughout so that students can identify common amphibians and reptiles in PA for this lesson and hopefully, in the wild. Video will reinforce traits of amphibians and reptiles Other handouts are read aloud and teacher highlights and clarifies important points. Live turtles can be brought in during warmer months to see close-up the characteristics they have. CD of frog and toad calls can be used to help students learn their vocalizations in case they he frogs calling outside of school.

Subject: Forestry and Wildlife

Unit 2: Forestry

Grade Level: 10-12

Designed by: Kevin Hilsey

School District: Tunkhannock Area School District

School: Tunkhannock High School

Brief Summary of Unit:

This unit will begin with a review of the basic traits of plants and a review of plant taxonomy. Then, students will study forest ecology- what is a forest? What are its component parts? And, how is this ecosystem different from others? Next, students will study dendrology- the scientific study of trees and shrubs. After this, students will be introduced to the tools and practices of forest measurement, with special emphasis on measuring merchantable timber using a Biltmore stick. After this, different forest management (silviculture) practices will be covered and contrasted with detrimental harvesting practices. Next students will learn about forest products with emphasis on which trees are used for which product. The history of U.S. forest preservation is covered next and the unit will end with an exploration of pest management.

Enrichment: In the Plant Taxonomy section, students can investigate further classification groups- for example, which families do some of the common trees fit into? For the forest strata diagram in the Forest Ecology (section 2), advanced students can research which birds and animals inhabit which strata of the forest and either cut and paste or draw more detailed plants and animals in these strata. For the Plant Taxonomy unit, advanced students can compare and contrast different plant classification systems and summarize them and then decide which system is the most useful to a forestry student. In unit 4, Forest Measurement, students can key out all shrubs, arthropods and herbaceous plants found during their forest inventory using classroom field guides.

Remediation: Unit 6, Wood Products, students can make a wood collage, showing different forest products and which trees they come from. Another option is to create a flip-book with trees named and pictures of their leaves, fruit and bark. During unit 2, forest drawings can be as detailed (showing very specific Pennsylvania trees), or just a "tree" depending on the level of the student. The same applies for which animals are in the forest. Students who have access to the Wood Tech shop, can obtain samples of oak, maple, ash and share these with classmates. They can also show and products produced in Wood Tech and why a certain wood was used in their manufacture. Some students may require adapted reading materials.

Unit 2: Forestry

Section 1: Plant Taxonomy

4.1.12.A. Analyze the significance of **biological diversity** in an **ecosystem**.
3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

Overarching Understandings

- Plants are multicellular organisms that are the main autotrophs in terrestrial ecosystems. Plants have cell walls made of cellulose and contain the green pigment chlorophyll inside of organelles called chloroplasts.
- Plant taxonomy is a complex science that is constantly evolving.

Topical Understandings	Essential Questions
<ul style="list-style-type: none">• Plants are classified first into two broad taxa (sometimes called sub-kingdoms): non-vascular and vascular, based on the presence of vascular tissue, then divided further based on method of reproduction (spores vs. seeds), then further based on more specific types of reproductive structures.• Plants can also be classified by life cycle- ie annual, biennial, perennial• Plants can also be classified by composition- woody or herbaceous;• Plants can also be classified by growth pattern- herb, shrub or tree.• Trees are woody plants usually over 15 ft. tall, when mature, and have a growth pattern that is generally taller than broad, with one main trunk.• Shrubs are woody plants usually less than 15' tall whose growth pattern tends to be broader than tall, with multiple trunks.• Herbaceous plants contain no woody tissue.	<ul style="list-style-type: none">• What are the main characteristics of plants?• How are trees and shrubs the same and how are they different?• What is a vine?• What are characteristics of non-vascular and vascular plants• What are some examples of vascular and non-vascular plants?• Which plants are vascular, but reproduce with spores?• What is the difference between a seed and a spore?• What two groups are seed—producing vascular plants divide into?• What are the two main groups of vascular plants?• What two groups can flowering plants be divided into, and what are the characteristics of each group?
Knowledge	Skills
<ul style="list-style-type: none">• Vocabulary: Herbaceous plant, tree, shrub, vine, vascular, non-vascular, fern, monocot, dicot, cotyledon, xylem, phloem, vascular cambium, flower, moss, liverwort, gymnosperm, angiosperm, evergreen, dioceious, monoecious, perfect, regular, sepal, petal, stamen, pistil, stigma, style, ovary, ovule, pollen tube, pollen grains, anther, filament, sexual reproduction, asexual reproduction, deciduous, coniferous, conifer, taxonomy	<ul style="list-style-type: none">• Describe the characteristics of: non-vascular vs. vascular plants; spore bearing plants vs seed plants; gymnosperms vs angiosperms; monocots vs dicots; and herbs, shrubs and trees.• Complete a diagram of a flower• Identify the function of plant parts- ie root, stem, leaf, flower• Describe conifer reproduction

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Using a blank flower chart and a word bank, students will correctly label parts of a flower.• Exam on Plant Classification	<ul style="list-style-type: none">• 70% or better matching on flower part activity• 70% or better on exam

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• <u>Plant Classification</u>- teacher-made Powerpoint presentation• Samples of moss, herbs, gymnosperms and angiosperms• Tree cross sections (doughnuts)• Flower model• Flower parts and plant parts worksheets• Conifer reproduction handout• Conifer cone set• Samples of different needles, flowers, herbaceous plants.• Plant Classification exam	<ul style="list-style-type: none">• Students will take notes or highlight a copy of the Powerpoint presentation.• Teacher will use models and samples to show what the different flower parts and conifer parts look like.• Students will complete a conifer reproduction worksheet which illustrates the stages and parts involved in conifer reproduction.• Students will complete a plant part worksheet to learn the name and function of various plant parts.

4.1.10.E: Analyze how humans influence the pattern of natural changes (e.g. primary / secondary **succession** and **desertification**) in **ecosystems** over time
 3.1.12.A2. Evaluate how **organisms** must derive energy from their environment or their food in order to survive.
 4.1.12.A. Analyze the significance of **biological diversity** in an **ecosystem**.
 Explain how species adapt to **limiting factors** in an **ecosystem**.

Overarching Understandings

- Forests are dynamic, complex ecosystems that are dominated by trees and have an interlocking canopy layer.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> There are both abiotic and biotic components to forests. There are different forest types differentiated by the dominant tree species. Forest type in any given area is determined by elevation, soil type, rainfall, latitude, age, and level of disturbance. Forest composition is dynamic and changes due to many factors, but also, if left undisturbed goes through predictable stages referred to as forest succession. 	<ul style="list-style-type: none"> How is a forest different than other ecosystems? Can there be a minimum or maximum size for a forest? How does climate and soil effect forest composition? How does human activity impact forest composition? Why do grasslands often evolve into forests? How do forests change over time? What limiting factors determine where a plant is found in a forest?
Knowledge	Skills
<ul style="list-style-type: none"> Vocabulary: shrub, tree, overstory, canopy, understory, herbaceous layer, shrub layer, suppressed, dominant, canopy, emergent, forest succession, primary succession, secondary succession, abiotic, biotic, climax, pioneer, virgin, old growth, primeval, shade-tolerant, shade-intolerant, strata, lichen 	<ul style="list-style-type: none"> Describe the vertical stratification of forests. Describe the steps and plant species involved in secondary forest succession Name at least 3 different abiotic components and how it is important to a forest ecosystem. Explain general forest type based on the dominant tree species. Describe major forest types in Pennsylvania

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Forest Diagram• Optional Exam on terms• Succession worksheet that goes with the secondary forest succession packet can be graded.	<ul style="list-style-type: none">• By creating a diagram of a typical forest, students can show their synthesis of many of the concepts in this section. The diagrams should include: at least 2 different abiotic components, biotic components shown and labeled, an interlocking canopy, each strata (layer of forest) clearly labeled, trees and plants that approximate a type found in the forest type chosen, a variety of herbaceous plants, animals drawn and labeled that would be found in that type of forest. (or in a particular strata of the forest, for advanced students).

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Copy of chapter 1 from the text: <u>Forestry</u>• Drawing paper• Notes on the components of forests• Notes on forest succession• Handout on Succession with question sheet• dvd: <u>History of Pennsylvania Forests with Jim Nelson</u> and video question sheet.• Optional extension activity- <u>Treetops Valley</u> story- can be used as a real-world example of secondary succession after a forest fire.	<ul style="list-style-type: none">• Students will read chapter 1 of the Forestry text, which explains the components of forests and describes the different forest sub-types found in the Deciduous Forest. biome.• Drawing paper for completing a forest diagram as described above.• Students will take notes on different types of forest succession from the projector.• Students will read and answer questions about which animals and plants are found in which stage of succession and differentiate between shade-intolerant pioneers and shade-tolerant climax species.• Students will view the video: <u>History of Pennsylvania Forests with Jim Nelson</u> and complete a worksheet that accompanies it to learn which tree species were the dominant trees in Pennsylvania, how and why they were harvested and how the forests have changed since the 19th century• Students can create a successional timeline based on the Treetops Valley story.

3.1.10.A8: Investigate the spatial relationships of **organisms' anatomical** features using specimens, models, or computer programs.
 3.1.12.A 5. Analyze how structure is related to function at all levels of biological organization from **molecules** to **organisms**.
3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

Overarching Understandings

- Dendrology is the scientific study of trees, and includes their identification, growth patterns, and life histories.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Dendrology requires an understanding of the principles of tree taxonomy, which uses specific terms to describe leaf shapes, margins and branching patterns. • Trees have different bark, silhouette, leaf arrangement, leaf shape, and twig arrangement patterns that can be used to identify the species. • MAD Horse is an acronym to remember opposite branching trees: maple, ash, dogwood, horsechestnut 	<ul style="list-style-type: none"> • What tools are needed to study dendrology? • Do most trees have opposite or alternate leaves? • Which trees in our area have whorled leaves? • Do most trees have simple or compound leaves? • Which trees in our area have compound leaves?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: dichotomous key, opposite branching, alternate branching, whorled branching, simple leaf, compound leaf, dentate, serrate, margin, entire margin, petiole, branch vein, midrib, blade, fruit, samara, key, pith, taxonomy, lobe, sinus, elliptical, obtuse. 	<ul style="list-style-type: none"> • Students will use a dichotomous key to identify the species of tree based on drawings and descriptions of leaf and branching pattern • Given different twigs of live trees with the leaves still attached, students will use a dichotomous tree key to identify the species.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">Using hands-on samples of leaves and drawings, and a dichotomous key, students will take a practicum evaluation which involves the identification of common tree species	<ul style="list-style-type: none">70% or better on a practicum evaluation.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">Dichotomous tree key to Pennsylvania trees<u>Peterson Guide to Trees of the Eastern United States</u>Tree leaf samplesPicture charts of tree leaves, tree silhouettes and leaf and twig patterns.Booklets: <u>Trees of Pennsylvania</u>	<ul style="list-style-type: none">Students will use a dichotomous key to practice identifying tree species based on pictures and descriptions, and then use the same or similar key to identify specimens in their practicum evaluation.Samples will be used for practice and the final evaluation.Picture charts of tree leaves and the booklet <u>Trees of Pennsylvania</u> will aid in identification.

3.1.10.A9: Explain the importance of accuracy and precision in making valid measurements
3.1.12.A 5. Analyze how structure is related to function at all levels of biological organization from **molecules** to **organisms**

Overarching Understandings

- Forest measurement includes measuring individual tree growth and volume and tree stand volumes.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • The diameter measurement of individual trees is taken at breast height (4.5 ft. from the ground on the uphill side) • Tree height is measured in logs (16ft. lengths in the Eastern U.S.) • Tree diameter measurements can be taken with a Biltmore stick or a diameter tape of tree calipers. • Log measurements are estimates based on a minimum of 8” in diameter, using a hypsometer or clinometer. • Merchantable height is the number of useful (straight, undamaged and over 8” diameter) logs in an individual tree. • A board feet is a 1” by 1’, by 1’ • Merchantable height in a given stand or sample plot in a forest is usually an estimate obtained by “timber cruising”- which is a quick inventory done by a professional forester. 	<ul style="list-style-type: none"> • How do you measure that amount of useful lumber contained in an individual tree or a stand of trees? • How is timber cruising done? • What are the three measurements that can be obtained by using a Biltmore stick? • What are the criteria for determining the merchantable height of a tree?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: Biltmore stick, saw timber, pole timber, seedling, sapling, cord, bolt, log, hypsometer, cubic foot, board foot, timber cruising, dbh, diameter tape, merchantable timber, clinometers, wedge prism, acre, stump height, increment borer 	<ul style="list-style-type: none"> • Use a Biltmore stick to calculate tree diameter within 2”, tree height in logs, and number of board feet in a tree • Calculate wood volume in board feet. • Create a 1/10 acre forest inventory plot • Conduct a forest inventory to identify species of understory shrubs, species of saw timber, species of herbaceous plants, # of pole timber trees, number of saw logs, total board ft.of merchantable timber within plot

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• A forest inventory of a 1/10 acre plot is the summative evaluation• Exam on forest measurement terms is another option	<ul style="list-style-type: none">• Students will be graded based on tree identification, shrub ID, and accurate measurements of dbh (within 2”), merchantable height (within 1 log) and total board ft. for each tree, and total for their plot.• 70% score on exam

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Biltmore sticks• Diameter tape• Nylon marking tape, Sharpie markers• Forest inventory worksheets, clipboards• Plastic bags- to collect leaf samples• Clinometer• 100' measuring tape, string• Wedge prism• Handout- <u>Forest Measurement</u>	<ul style="list-style-type: none">• Before students can begin taking forest measurements or using the Biltmore sticks, they need to be able to measure their pace (2 steps), so that they can count off 66' from a tree to be measured without using a tape in the forest. To do this, practice needs to be conducted in an open field where 66' is measured and students practice until they know their approximate pace.• Forest inventory of plots measuring 1/10 acre in diameter (37' radius) can be created in the school woodlot, either ahead of time, or by the students. Groups of 3-4 students are assigned, and perimeter is marked. All merchantable trees are flagged, numbered, identified and measured, Also measured is approximate number of seedlings, saplings, pole timber and the species of as many of these as possible are identified.

4.1.10.B Analyze the impact of **technology** on the management, distribution, and disposal of **natural resources**
 4.1.12.A. Explain how species adapt to **limiting factors** in an **ecosystem**..

Overarching Understandings

- Silviculture is the art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Pruning, thinning, all contribute to a healthier woodlot • Timber Stand Improvement is the practice of removing dead and diseased trees, trees with poor form and poor quality trees to improve the overall stand productivity • A stand is a group of trees in the same age class or of the same species • A pure stand is a stand with at least 90% of the same species. 	<ul style="list-style-type: none"> • What effect does pruning, thinning, sanitation have on the health of a forest? • What are the stages of a seed-tree harvest? • Is clearcutting a legitimate silviculture practice? If so, when is it indicated? • How is a seed tree harvest different from a shelterwood harvest? • What is high grading? • How is sanitation different from salvage? • What are the reasons not to harvest a tree?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: pruning, felling bucking,skidding, landing, de-limbing, high-grading, diameter limit cutting, seed tree harvest, clearcut, forester, logger, sheterwood harvest, seed-tree harvest, timber stand improvement (TSI), sanitation, salvage, sustainable harvest, stand, pure stand. 	<ul style="list-style-type: none"> • Students will explain the uses of silviculture techniques to manage the forest ecosystem: thinning, clear-cutting, seed-tree method, shelter-wood, and selection method. • Describe the steps of harvesting a tree, from felling to loading, using the correct terminology. • Describe the practices of high grading and diameter limit cutting

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none"> • Silviculture Exam • Pruning practice 	<ul style="list-style-type: none"> • 70% or better grade on exam. • Teacher will demonstrate proper pruning and ask a few student volunteers to prune some small pole timber trees. Teacher will evaluate how the volunteers pruned and point out the positive and negatives of their efforts.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none"> • Chainsaw, pruning saw, pole pruner, hand pruners, loppers, hedge trimmers, chaps • Student handouts- <u>Silviculture: Making a Stand</u>, and <u>Harvesting Trees</u>. 	<ul style="list-style-type: none"> • Students will use hands-on tools (except chainsaw) to learn how they are used in silviculture • Students will read packets and complete the worksheets that go with them.

Unit 2: Forestry

Section 6: Forest Products

<p>4.3.10.B Describe the use of a natural resource with an emphasis on the environmental consequences of extracting, processing, transporting, using, and disposing of it</p>

<p>Overarching Understandings</p> <ul style="list-style-type: none"> • Forest products refers to products obtained from trees and includes firewood, lumber, paper, engineered wood products, fruit and nuts, wood chemicals and others.
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Topical Understandings	Essential Questions
<ul style="list-style-type: none"> • Forest products are used by everyone • Forest products are a renewable natural resource when obtained in a sustainable manner. • Hardwood trees are more valuable trees that are used for firewood, furniture and anywhere that a more durable product is 	<ul style="list-style-type: none"> • What are the three main uses of forest resources? • What are the principal uses of hardwoods vs. softwoods? • Which tree species in Pennsylvania are in most demand? • Which tree species in PA is the most valuable? • What are the 10 most important hardwoods in Pennsylvania?

<p>needed.</p> <ul style="list-style-type: none"> • Softwoods are primarily used for paper products, wood chemicals, biomass fuels and construction lumber. • Engineered wood products have replaced traditional lumber because they are cheaper and in many cases, more durable. 	<ul style="list-style-type: none"> • What is the difference between OSB, particleboard and plywood? • What is veneer and which trees are used to make it?
Knowledge	Skills
<ul style="list-style-type: none"> • Vocabulary: pith, summer wood, spring wood, reaction wood, xylem, sapwood, heartwood, phloem, pith ray, annual ring, cork, cork cambium, quarter sawn, plane sawn, plywood, particle-board, OSB, hardboard, Masonite, veneer, board foot. 	<ul style="list-style-type: none"> • List products and uses of the most important commercial tree species grown in Pennsylvania: ash, maples, oaks, hickories. Black cherry, Tulip Poplar, American Beech, hemlock and pine. • Describe the different engineered wood products and their uses.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none"> • A practicum test using wood samples will be given at the end of the unit. Students will be asked to identify different species of tree, as well as different engineered wood products, then list for at least half, which trees they are made from. 	<ul style="list-style-type: none"> • A passing grade on the wood products practicum.

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none"> • Handouts: <u>10 Important Hardwoods</u>, <u>Forest Resources</u>, <u>Paper</u>, <u>Paper Making-blenders</u>, <u>newspaper</u>, <u>screening (CSI teacher usually has these)</u> 	<ul style="list-style-type: none"> • Students will read the <u>10 Important Hardwoods</u> packet and list at least 3 uses for each of the trees. • Students will read the forest resources packet and describe how paper, baseball bats and engineered wood products are made, via a worksheet for each. • Students can make paper in class, using department materials that are used in the CSI class.

4.3.10.A: Describe how local and state agencies manage **natural resources**
4.5.10.A: Explain how public policy encourages or discourages the sustainable use of **natural resources**
 4.1.12.A. Analyze the significance of **biological diversity** in an **ecosystem**.

Overarching Understandings

- Forest Preservation is an essential part of maintaining ecosystem diversity in our country and is a cooperative effort of citizens, private landowners, state and national forest services, and state and national parks.

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> Forests are finite ecosystems that need conservation. Forests are a renewable natural resource if used sustainably. Sustainable harvests of the forest resource ensures that they are not diminished or degraded for future generations. Personal values impact how resources are utilized. State and Federal laws protect public forests. Many forest resources in the east are owned privately. White-tailed deer have the biggest impact on eastern forests of any herbivore. 	<ul style="list-style-type: none"> Is Conservation the same as preservation? What is the difference between national forests and national parks? Which organization is responsible for each and what is their operational mandate? What are your personal conservation values? Are there some resources that are more deserving of protection than others? Are there some resources that can be exploited without damaging them or running out of them?
Knowledge	Skills
<ul style="list-style-type: none"> Vocabulary: exclosure, overbrowsing, keystone species, regeneration, exploitation, preservation, conservation, utilitarian, aesthetic value, intrinsic value, biodiversity- genetic, ecosystem, population. 	<ul style="list-style-type: none"> Students will be able to synthesize conservation terminology and examine their own values to create a personal essay on conserving forests resources. Students will be able to match conservationists with their cause and correctly define conservation terms. Describe the potential for pollution from timber harvesting and the practices used to minimize erosion and sedimentation. Explain the three levels of biodiversity Explain the value of forest lands as community water sources.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none">• Personal conservation essay• Conservation Quiz• Rage over Trees worksheet	<ul style="list-style-type: none">• Students will examine and discuss their personal values regarding different conservation topics and will be able to write an essay about these values, using correct terms from the unit and also be able to compare and contrast their values with one or more famous conservationists.• 70% or better on Conservation Quiz• <u>Rage Over Trees</u> worksheet can be graded to see if students have learned both sides of the clearcutting debate and are able to formulate their own opinion on the topic

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Readings: <u>History of U.S. conservation movement</u>, <u>History of Conservation in Pennsylvania</u>, Hetch-Hetchy dam controversy handout, <u>History of PA Game Commission</u>.• vhs tape: <u>Rage over Trees</u>	<ul style="list-style-type: none">• Students will read handouts on the history of conservation nationally and at a state level and identify national and statewide issues.• Students will be able to associate famous conservationists with the issue that they fought for and what their values were.• The video <u>Rage over Trees</u> is about clearcutting controversy in Old Growth forests in the west and can be used to debate opposing values and also describe the characteristics of virgin forests. It has a worksheet to accompany it.

4.5.10.B Describe the impact of Integrated Pest management practices in the Environment
 3.1.12.A1. Relate changes in the environment to various **organisms'** ability to compensate using homeostatic mechanisms
3.1.10.A3: Compare and contrast the **life cycles** of different **organisms**.

Overarching Understandings

- Invasive pests are serious threats to US forests and each requires unique management strategies

Topical Understandings	Essential Questions
<ul style="list-style-type: none"> Some insects act as vectors to infect trees with either bacterial, fungal or viral parasites Most insect pests are invasive species that have no natural controls in U.S. forests. Integrated pest management often involves a combination of physical, chemical and biological controls. Some pests are generalists (Japanese Beetle), and some are specialists (Hemlock Woolly Adelgid) 	<ul style="list-style-type: none"> Why do invasive pests cause more damage than native insects? What measures can be taken to prevent invasive species from spreading? How are invasive pests controlled?
Knowledge	Skills
<ul style="list-style-type: none"> Vocabulary: invasive species, quarantine, integrated pest management, sanitation, <i>Bacillus thuringiensis</i> (bt), pesticide, insecticide, vector, biological control, pathology, canker, stump sprout, defoliate. 	<ul style="list-style-type: none"> Identify at least 3 insect pests by sight and be able to describe which species they attack and the impact they cause. Describe the unique mechanical, chemical and biological controls used to combat different pests. Describe the life cycle of common forest pests. Describe the strategy of specialist vs. generalist insect pests.

Assessment

Evaluation Criteria	Evidence of Understanding
<ul style="list-style-type: none"> Hands-on identification of pests Quiz on Insect Pests 	<ul style="list-style-type: none"> Practicum with pictures and samples of invasive species and their signs 70% on Quiz

Materials and Resources

Source	Description of Use
<ul style="list-style-type: none">• Flipchart of photos of invasive species and pictures of their “signs”• Specimens of emerald ash borer, Asian long-horned beetle, Hemlock Woolly Adelgid, Japanese Beetle.• Handouts on individual insect pests- Woolly Adelgid, Asian Long-horned Beetles, Emerald Ash Borer, Japanese Beetle, Gypsy Moth, etc.	<ul style="list-style-type: none">• Students will view specimens and picture evidence of pest damage.• Students will look at photos and flipcharts of pests and pest signs.• In groups, students will read handouts on individual insect pests and then summarize their assigned pest to the class.