Study Guide

for Middle School and High School

FOR USE WITH
THE FILM

FROM BILLIONS TO NONE

THE PASSENGER PIGEON'S FLIGHT TO EXTINCTION

Author

Lena Verkuilen
Certified Interpretive Guide
Director, Welty
Environmental Center
Beloit, Wisconsin

Editors

David Mrazek
Director, Co-producer, Co-writer
From Billions to None
www.billionstonone.com

Joel Greenberg
Co-producer, Co-writer
From Billions to None

Author
A Feathered River Across the Sky: The Passenger Pigeon's Flight to Extinction
Bloomsbury, USA, 2014

Educational Distributor

The Video Project/
Specialty Studios
www.videoproject.com

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Introduction

On September 1, 1914, Martha, the last passenger pigeon on Earth, died in captivity in the Cincinnati Zoo. The film *From Billions to None* documents this awesome force of nature, from the flocks that blocked out the sky for days, to remembering how and why this once most abundant species was driven to extinction — by us. Today more than ever, the forces of humanity are causing more and species, many of which people barely know exist, to go extinct.

The film and study guide are tools to help you teach the lessons of past extinctions, what is happening today, and how to learn from our past. The lessons cover not only the disciplines of science and history, but present opportunities to include art, service learning, community action and debate.

The study guide lessons correspond directly to current United States curriculum standards. In addition to Common Core standards, which address math and language arts, we have included Next Generation Science Standards, which many states are adopting as well. Please see the tables on page 5 and 6 to see which math, English and science standards apply to each chapter lesson.

The lessons are applicable to both middle school and high school students, and are designed to be done in a classroom setting both inside and, where possible, on the grounds of the campus. Extensions are available to broaden the experience beyond the classroom and involve the larger community.

Students are likely to experience several emotions along with viewing the film, and the study guide is a way to turn that emotion into positive experiences that have an impact on the world today. You may present the film one chapter at a time, along with corresponding lessons, or show the entire film and choose the lessons that speak most directly to your students.

The filmmakers made a special attempt to include young people in the film so that students of various ages will see themselves while learning about this topic. Most important, young people will see that they are an essential part of the solution to the challenges presented. The story of the extinction of the passenger pigeon is is sad, yet the movie is also hopeful, and as a cautionary tale can serve as a call to arms on the topic of sustaining the current web of life.

Middle School Standards

Both the lessons and the extension activities such as field trips offer opportunities to cover curriculum standards.

	NGSS Science		Common Core Mathematics					Common Core English Language Arts						
	LS2	LS4	RP	EE	F	G	SP	R I	W	L	SL	R H	R ST	W HST
CHAPTER 1 Introduction to Joel and the Bird	1, 2, 4, 5						6, 7	1-9				1-9	1, 4, 8, 9	2, 4, 9
CHAPTERS 2 & 3 Joel's Passenger Pigeon & The Project Passenger Pigeon People	2-5		7				6, 7	1-9			1-4, 6	1-9	1, 2, 4, 9	1-9
CHAPTER 4 Boris Worm and Overfishing	1-5							1-9			1-4		1-9	1, 4, 7-9
CHAPTERS 5 & 6 Experiencing the Flocks Firsthand & Chicago Academy of Sciences Visit	1-5		7				6-7	1-9			1-6		1-9	1-9
CHAPTER 7 The Web of Life	1-5	4-6						1, 3, 4, 7			1-6		1-9	1-9
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CHAPTER 9 The Wisconsin Nesting and Shooting	1-5	4, 6	7	7-8	8	6-7	6-7	1-9			1-6	1-9	1-9	1-9
CHAPTER 10 Oceans and Sharks in Peril	1-5	4-6	7			6-7	6-7	1-9			1-6		1-9	1-9
CHAPTER 11 Wyalusing Monument and Extinction Theory	1-5	4-6					6-7	1-9			1-6	1-9	1-9	1-9
CHAPTER 12 Martha at the Zoo — Yesterday and Today	1-5	4-6					6-7	1-9			1-6	1-9	1-9	1-9
CHAPTER 13 A Modern Conservation Ethic and Extinction	1-5	3-6	7				6-7	1-9			1-6	1-9	1-9	1-9
CHAPTER 14 De-extinction and the Passenger Pigeon	1-5	1, 2, 4-6	7				6-7	1-9			1-6	1-9	1-9	1-9
CHAPTER 15 A Mural in Downtown Cincinnati	2, 5					6-7						1-9		
CHAPTER 16 Species Importance and Joel's Favorite Place	1-5							1-9	1-6	1-9		1-9		
CHAPTER 17 Challenges, Success Stories and the Future	1-5	4-6					6-7	1-9		1-6	1-6	1-9	1-9	1-9

Next Generation Science Standards are Life Science 2 and 4; Common Core Mathematics standards are Ratios and Proportional Relationships, Expressions & Equations, Functions, Geometry, Statistics & Probability; and Common Core Language Arts standards are Reading: Informational Text, Writing, Language, Speaking & Listening, Reading: History/Social Studies, Reading: Science & Technical Subjects, and Writing: History, Science & Technical Subjects.

High School Standards

Both the lessons and the extension activities such as field trips offer opportunities to cover curriculum standards.

	NGSS Science		Common Core Mathematics						Common Core English Language Arts						
	LS2	LS4	N-Q	F-IF	G-MG	S-ID	S-IC	S-CP	R I	W	L	SL	R H	R ST	W HST
CHAPTER 1 Introduction to Joel and the Bird	2, 6-8		X				X		1-9				1-9	1, 4, 8, 9	2, 4, 9
CHAPTERS 2 & 3 Joel's Passenger Pigeon & The Project Passenger Pigeon People	1, 2, 4-7	6				X	X		1-9			1-4, 6	1-9	1, 2, 4, 9	1-9
CHAPTER 4 Boris Worm and Overfishing	1, 2, 4, 6-8		X	X		X	X	X	1-9			1-4		1-9	1, 4, 7-9
CHAPTERS 5 & 6 Experiencing the Flocks Firsthand & Chicago Academy of Sciences Visit	2-8		X	X	X	X	X	X	1-9			1-6		1-9	1-9
CHAPTER 7 The Web of Life	1, 2, 6, 7	5, 6	X	X		X	X	X	1, 3, 4, 7			1-6		1-9	1-9
CHAPTER 8 Strategy Meeting	2, 5-8	5, 6	X		X	X	X		1-9			1-6	1-9	1-9	1-9
CHAPTER 9 The Wisconsin Nesting and Shooting	1, 2, 4, 6-8	4-6	X		X	X	X		1-9			1-6	1-9	1-9	1-9
CHAPTER 10 Oceans and Sharks in Peril	1, 2, 4, 6-8	3-6	X	X	X	X	X	X	1-9			1-6		1-9	1-9
CHAPTER 11 Wyalusing Monument and Extinction Theory	1, 2, 6-8	3-6	X	X		X	X	X	1-9			1-6	1-9	1-9	1-9
CHAPTER 12 Martha at the Zoo — Yesterday and Today	2, 6-8	3-6	X			X	X	X	1-9			1-6	1-9	1-9	1-9
CHAPTER 13 A Modern Conservation Ethic and Extinction	1, 2, 4, 6-8	4-6	X	X		X	X	X	1-9			1-6	1-9	1-9	1-9
CHAPTER 14 De-extinction and the Passenger Pigeon	1, 2, 6-8	3-6	X			X	X	X	1-9			1-6	1-9	1-9	1-9
CHAPTER 15 A Mural in Downtown Cincinnati	2	6			X								1-9		
CHAPTER 16 Species Importance and Joel's Favorite Place	1, 6-8					X	X	X	1-9	1-6	1-9		1-9		
CHAPTER 17 Challenges, Success Stories and the Future	2, 6-8	4-6	X			X	X	X	1-9		1-6	1-6	1-9	1-9	1-9

Next Generation Science Standards are Life Science 2 and 4; Common Core Mathematics standards are Number & Quantity, Functions: Interpreting Functions, Geometry: Geometric Measurement; Statistics: Interpreting Data, Inferences & Conclusions, and Conditional Probability; and Common Core Language Arts standards are Reading: Informational Text, Writing, Language, Speaking & Listening, Reading: History/Social Studies, Reading: Science & Technical Subjects, and Writing: History, Science & Technical Subjects.

Chapter One

Introduction to Joel and the Bird

General Theme	The natural history of the passenger pigeon and the impact on the larger ecological system.
Lesson Objective	Understand the life history of the passenger pigeon *(Ectopistes migratorius)* and how it fit into the larger ecology. Look at the larger systems to hypothesize why the most numerous species of bird on the planet went extinct in such a short time.
Time Allowed	60-90 minutes, if including extensions could extend over multiple sessions
Location	Indoors (outdoors with service learning extension)

Background Information

Passenger pigeons famously filled the skies with their sheer numbers. Flocks were reported as including billions of individuals. Accounts by naturalists and others indicate that passenger pigeons were likely the most common bird on the face of the Earth. Within a space of about 40 years the numbers of passenger pigeons went from plentiful to extinct. There were many factors that will be explained more deeply in the remaining documentary highlighting specific reasons that contributed to their decline.

Passenger pigeons often traveled in large flocks over a wide area of the Eastern United States and Canada. They traveled wherever there was enough food to support the large flocks. Passenger pigeons ate a variety of foods, but preferred mast, or hard nuts from hardwood trees, particularly oak and beech. Historical records vary, but most experts agree that passenger pigeons likely mated one time a year, and produced one egg per set of parents. Passenger pigeons were always on the move, flying over their range searching for sites to feed, nest or roost. Their large numbers required large food sources, so they followed these. There were millions to billions of individuals in each flock, so they had too many individuals to settle in one area for too long, as they would quickly deplete the resources they required.

Many native people and later the European settler could not count on the passenger pigeon flocks as a regular food source due to their always being on the move, but when the pigeon flocks arrived, people hunted them as food. Many native cultures would collect the squabs, or young pigeons, from nesting sites. Hunting the adults was often considered taboo.

Adult pigeons nested in such large numbers that trees often broke under the weight of the birds. The dung produced at large nesting or roosting (when birds would rest) sites often killed any plants at the site. However, historical accounts noted that the soil in future seasons was often the most fertile around.

Many factors may have caused the extinction of the passenger pigeon. Because the female laid only one egg each year, when flocks were hunted continuously they could not replace the numbers of individuals lost. Technology advanced to the point that people knew quickly where pigeons were nesting or roosting, and expansion of the railroads made it easy to transport large amounts of birds caught in remote areas. Increasing human populations also increased demands for natural resources, including timber for building cities and land for development. More people began to live in cities, and urban populations required plentiful, cheap sources of food. The pigeons were hunted commercially to provide food. Squabs were also rendered into fat; trees used by pigeons for nesting and roosting sites were harvested for timber, and people simply moved in and cleared once-timbered land for agriculture and settlement.

Timeline

12,000 BCE	Earliest archaeological evidence of the passenger pigeon.
1534	Jacques Cartier leaves the first written account of the passenger pigeon while exploring the Atlantic coast of Canada, describing an infinite number of the birds flying over Prince Edward Island.
1625	A Dutch writer on Manhattan Island noted passenger pigeon flocks shutting out the sunshine, and early Manhattanites shooting birds from their front porches
1750's	Observant English colonists voice concern that passenger pigeon flocks were smaller than past years, the first expression that the species was not immune from impact of human activities.
1857	A proposed bill seeking protection for passenger pigeon was up for a vote. A select committee of the Ohio State Senate reports that the passenger pigeon needs no protection, that the birds are wonderfully prolific and no ordinary destruction can lessen that.
1900	After years of relentless hunting, the easiest way to now see a likeness of the passenger pigeon is in a bird collector card series for Arm and Hammer brand baking soda.
September 1, 1914	Martha, the last passenger pigeon alive on the planet, dies in captivity in the Cincinnati Zoo rendering the species extinct.

Materials Required

- Pictures of living pigeon and dove species as well as pictures of passenger pigeons printed from Internet. Laminate if using more than one time. Species to include are: mourning dove, ringed turtle dove, rock dove, and passenger pigeon.
- Common and scientific names of each species displayed.
- Facts about the passenger pigeon's natural history from the film, listed resources, and web searches.
- Timeline from the film and background information with dates and important events in the history of the passenger pigeon story. Include pictures if you can. Again, laminating these items is suggested if using more than one time.
- Pictures of other extinct species, including the Carolina parakeet, dodo, Labrador duck, great auk, California golden bear, Eastern elk, and Newfoundland wolf.

Procedure

Gather pictures in the classroom or search on the Internet for pictures of living pigeon and dove species and the passenger pigeon. Have cards with the common and scientific names of each of the species available for each picture. It is best to laminate these cards so they can be used multiple times.

Watch the first chapter of the film. Ask the students for any initial responses to the content.

Talk about different species of doves that are alive today and how they compare to passenger pigeons. Have the pictures of the different dove species posted around the space. Have students try to match the names of the species to the pictures. Go over the answers and change any where necessary. You can have multiple copies of each picture and name and do this activity in small groups. Each group can show which they think is which after a few minutes. Many people confuse passenger pigeons with carrier pigeons, homing pigeons or rock doves (common city pigeon). Point out the passenger pigeon picture and tell the students you will now talk about what made this species unique.

Students can list out details they noted from the film including coloration of the bird,habit of always moving to find food, sheer numbers of the flocks and their place in human lore.

After watching the first chapter of the film, review what extinction means and ask students to hypothesize various reasons passenger pigeons became extinct.

Students can search resources including those listed in this curriculum and on the Internet to find specific facts about the passenger pigeon.

Point out the timeline posted in the classroom or other space outlining the history of the passenger pigeon. Have the actions on cards separate from the dates, and if using them, pictures highlighting the events. Have students match events on the timeline to the dates after watching the film. Talk about how each activity impacted the life of the passenger pigeon, and perhaps how things may have been different had a different action been taken.

Assessment

Keep photos of pigeon and dove species up throughout investigation. Periodically ask students to identify which species are which.

Check in with groups of students about their timeline investigations and how human activity both fits into the timeline, and how it affected the life of the pigeons.

Extensions and Adaptations

Post the timeline used in the film (see listing in resource information) around the classroom or other space. Have students research other events in human history to post along the pivotal events in passenger pigeon history. Some suggested areas to focus on are: agriculture, industry, technological advances in travel and communication, and government legislation. These events can be used at a later date to revisit the hypotheses about why the passenger pigeon went extinct.

Visit a local park or explore the schoolyard for aspects of habitat that species require.

Set up a feeding station, ideally where students can see it on a regular basis, and monitor what species and how many individuals of each species visit the site. Participate in Project Feederwatch through the University of Cornell to contribute data to their studies.

Investigate local species that are threatened or endangered and have students investigate reasons why this is happening. The class can choose one on which to focus and work with local Department of Natural Resources officials, Audubon Society, land preservation or other stewardship groups to help restore habitat, and/or present educational information to the general public to raise awareness and encourage action. See how human activity can follow the ripple effect for positive outcomes for local species and habitats.

Have the students help set up a feeding station, either at home, or if possible at the school site where students can observe it on a regular basis. Observe birds at the feeding station, particularly dove and pigeon species that visit. Record data on the species, numbers of individuals, behaviors while feeding, and draw or describe the birds. This will give students a familiarity and connection to local bird species.

Chapter Two & Chapter Three

Joel's Passenger Pigeon & The Project Passenger Pigeon People

General Theme	People have a passion for conservation projects. This passion can ignite others to care about conservation issues and work for a solution.
Lesson Objective	By using the lessons of the passenger pigeon extinction as a guide, students will look at local environmental issues or global issues that impact them locally. They will find a passion to learn about, then educate others and develop solutions before it is too late.
Time Allowed	60-90 minutes for the initial viewing and discussion. If there is a social justice or community education piece, this lesson may extend over several weeks.
Location	Indoors (outdoors with service learning extension)
Background Information	There are more preserved specimens of passenger pigeons in museums and other collections than any other extinct species. This makes sense as the passenger pigeon was once the most plentiful bird species on the planet when it was alive. The specimen that Joel Greenberg is using was taxidermied in Maine by a collector who had it for 50 years. The specimen was then given to a woman in New Hampshire who had it for 8 years, selling it to a friend of Joel Greenberg's in Louisiana. This man had the mounted passenger pigeon for about a week before sending it to Greenberg for his use in educating people about the extinction and the lessons to be learned. A case was designed so Greenberg could safely transport the specimen when he traveled to give lectures about the extinction. Greenberg's passion for sharing the passenger pigeon story is infectious. When he recounts the story and shows

his beautiful but lifeless passenger pigeon, people see how we can learn from this event and not repeat the past. Each connection is a spark to spread the fire of being conscientious about our use of natural resources and living a sustainable life.

The scene where Joel Greenberg talks with other conservationists and educators about Project Passenger Pigeon helps to link the lessons of the extinction with current conservation issues. Passion and connection to an issue can spark people to solve problems and move situations forward. Understanding that the passenger pigeon went from being the most plentiful bird species on earth to being extinct within a few decades helps to spark this passion in new audiences. Use these two chapters of the film and this session as a chance to ignite passion in your students regarding current local environmental and conservation issues that they can impact.

Materials Required

- Ideas of local environmental issues or global issues that impact the local community
- Access to Internet for research
- Potential permission to use public or school space for an educational event
- Knowledge on how to speak at local governmental meetings to bring up environmental issues
- Contact information for governmental agencies and representatives

Procedure

Watch the second and third chapter of the film. Ask the students for any initial responses to the content. Discuss local and timely regional and global environmental and conservation issues. These could range from local ordinances on the ballot for local parks and conservation areas, use of fossil fuels, water use in drought-stricken areas, or climate change due to human activity.

Identify one large issue the class in general is interested in and passionate about working to solve. There may be smaller subtopics that groups of students may want to be personally involved in helping to resolve.

Divide the students into small groups. Each group will choose a subtopic of the larger issue to discuss. Students will be tasked with finding a way they can make a local and measurable impact. Students should choose a topic that they are personally invested in to make the largest impact.

Each group of students will draw up a plan that involves outlining the particular problem, identifying the user group or species most affected, designing a plan for educating the local public about the problem, identifying possible solutions to the problem and implementing possible actions to ease the problem or offering solutions.

For example, the students might identify water use as a problem in the area. They can research how much water is being used by which constituents and how much is being wasted. Students can set up a water use day at the school or a local park and invite the public to hear how to use water in more efficient ways.

If the students are very passionate about the issue/s discussed they may want to extend the experience to talk with local governmental representatives. They might petition time to talk about the issue at a city council meeting, county board meeting, or set up a time to meet with a state or congressional representative to discuss laws around the issue.

Assessment

Collect the plans outlining the problem and possible resolutions. Have groups present to the class their work on the issue and any measurable impacts made. This may be a resolution taken up by the local city council, having a response letter from a local lawmaker, or data collected on change in behavior of constituents as a result of their education.

Student engagement with the issue will show how passionate particular students are about a local issue. If the entire class can rally around one issue you can make a larger impact, but there may be multiple issues discussed to engage the entire group.

See how far along students want to investigate the issues. Some may be resolved with community education events and some may involve local lawmakers. Having students turn in letters before sending them to lawmakers, or setting up a social media campaign can be used to assess student involvement.

Extensions and Adaptations

This lesson may be done as in-class discussion alone.

Research larger environmental issues that the students care about. This may result in a ripple effect.

In researching the issues the students have chosen, connect with a local group that is working on the same issue. This may be a non-profit, a parks commission, the Sierra Club or others. There may be efforts already underway with these organizations that students can help in planning and implementing.

Chapter Four

Boris Worm and Overfishing

General Theme	The lessons learned by the 1914 extinction of the passenger pigeon can impact decisions made regarding the current state of the world's fisheries and the management of this important global natural resource.
Lesson Objective	By using the lessons of the passenger pigeon extinction students will look at current issues affecting worldwide commercial fisheries.
Time Allowed	60-90 minutes for the initial viewing and discussion. This lesson may take multiple class sessions if you choose to include a field trip, speaker, or add a debate that students will need to prepare for in advance.
Location	Indoors; outdoors with possible extensions.
Background Information	Modern commercial fisheries use similar techniques to those that contributed to the extinction of the passenger pigeon. The advanced technology used by fishing vessels relentlessly seeks out huge schools of fish. Vessels are equipped so they are able to fish further from shore and for longer periods of time than those in the past. Fishing vessels are also faster so the fish are less likely to escape nets and lines. There have been changes made to commercial fishing in recent times. Quotas are set and enforced, but only in countries that have the resources to enforce them. Stiff fines and restrictions on licenses are issued to commercial fishermen who ignore laws and seasons on fish. This is in response to data on the decline of fisheries worldwide. In the film, marine biologist Boris Worm presents cod fishing as a cautionary example. For 500 years cod was a fantastically abundant fish species that was fished selectively with nets and hand lines. Then modern commercial deep trawlers with radar, sonar and GPS progressed to where entire schools of cod were being harvested at one time, like huge passenger pigeon nesting sites that were spotted by railroad agents and subsequently decimated by commercial and local hunters. In 1992, Northwest Atlantic cod fisheries completely collapsed and a moratorium on fishing was enforced, resulting in the loss of over 30,000 jobs in Canada and the United States. After twenty years strict quotas are being enforced and there are finally signs of some recovery in selected areas, but there will be no return to increased levels of cod fishing for many years to come. Cod is just one example. According to the World Wildlife Federation more than 85 percent of the world's fisheries have been pushed to or beyond their biological limits and are in need of strict management plans. But there would not harvesting of fish in such large numbers if not for consumer demand. Research can be done as to how

to change eating habits of consumers and how fisheries can focus on sustainable practices that conserve ecosystems and sustain livelihoods. Recently there has been an increase in fish farming. Some of these farming practices are sustainable, but others create new problems, such as overfishing species used for fish feed and creating pollution from fish farm waste. Aquaponics technology has devised using fish waste to fertilize plants prior to the fish being harvested. Students can research the newest techniques being used in sustainable fisheries as well as continuously updated changes in the commercial fishing industry.

Materials Required

- Pictures of fish species commonly used for food, including cod, perch, salmon, shark, swordfish, snapper and other local favorites
- Access to Internet for research
- Field trip to a local fishery, seafood restaurant, or natural resources office
- Access to fishing equipment for possible extension — check with a local fishery or fishery-related nature center

Procedure

Watch the fourth chapter of the film. Ask the students for any initial responses to the content. Discuss the techniques used by modern commercial fisheries and how these mirror those utilized in harvesting passenger pigeons in the 1800s and early 1900s.

Talk with the class about their habits of eating fish. Does it make a difference what species of fish is consumed? Do the students know where and how the fish they consume are caught?

Divide the students into small groups. Each group will choose or be assigned a fish species to research. They should collect data including estimated numbers of species worldwide, how the fish species fits into its ecosystem, the demand for that fish as a food resource and the techniques used to catch that species of fish and the estimated numbers caught annually.

If possible, arrange a field trip to a local restaurant that serves fish or invite a local seafood chef to talk with the students. Ask the chef where then restaurant's fish are being sourced and how many fish they prepare at the restaurant every week.

Have students research where fish served at various restaurants comes from: McDonald's Filet-o-fish, Red Lobster, etc. Are these fish sustainably harvested? There are cards and other resources available online that offer advice on ordering fish at restaurants or buying sustainable harvested fish to prepare at home. Have the students research this information and share it with their families to make decisions about consuming seafood.

Have a class debate about fish consumption and its relationship to overfishing. Topics can include consumption of fish species that are harvested in an unsustainable way, fish farming, the mass harvesting of smaller fish species such as Menhaden to feed farmed fish, worldwide fish consumption in this and other cultures, and changing eating habits to live more sustainably on earth. This debate may get heated as students may have strong opinions, so be prepared to moderate.

Assessment

Have students prepare questions for a guest speaker or field trip that involves a chef, fishery manager, or natural resources officer. You may want questions to be turned in ahead of time for approval to make sure they are on topic and appropriate.

Moderate the debate about fish consumption and a link to overfishing. Students can be assessed on prepared pieces for the debate, and on rebuttals and questions.

Extensions and Adaptations

This lesson may be done as in-class discussion and debate alone.

Arrange a field trip to a local seafood restaurant to talk with a chef about where fish are being sourced for the restaurant and how many are prepared at the restaurant. Other field trip options can be touring a local fishery — wild or farmed, meeting with natural resource officers about how local wild fisheries are being managed, or tour a local commercial fishing vessel. These resources maybe invited in to the classroom to give a presentation if a field trip is not feasible. This would be a good option to have before a class debate to add information for the students to use in formulating their opinions.

Arrange a class fishing trip to a local site. Be aware of all fishing rules and regulations in your area. In many states children under a certain age do not need a fishing license, but older teens and adults assisting do. Many states also have one day fishing licenses available if this is all you need. You can coordinate with a local nature center or fishing club to arrange the event and have volunteers help with bait and taking fish off hooks. Catch and release is advisable for this outing so you do not have to be concerned with limits, transporting fish and cleaning fish. Having a chance to experience fishing for pleasure will connect students to fish personally as a resource they can manage sustainably, and they will have a more personal connection than just consuming them as food.

Chapter Five & Chapter Six

Experiencing the Flocks Firsthand & Chicago Academy of Sciences Visit

General Theme	Natural resources, no matter how vast, can be completely consumed if not managed in a sustainable way.
Lesson Objective	By using the lessons of the passenger pigeon extinction as a guide, students will look at managing natural resources, both renewable and nonrenewable, for sustainable use.
Time Allowed	60-90 minutes for the initial viewing and discussion. This lesson may take multiple class sessions if you choose to include a field trip or speaker. Trash and resource survey can take up to a week to complete, with another class session for follow-up discussion.
Location	Indoors; outdoors with possible extensions.
Background Information	Both the film and *A Feathered River Across the Sky: The Passenger Pigeon's Flight to Extinction* by Joel Greenberg contain numerous accounts of the vast flocks of passenger pigeons once present in North America. Many Native American cultures relied on passenger pigeons as an important, if inconsistent, source of food. European settlers and subsequent Americans hunted passenger pigeons on a small scale and sold them at local markets. Accounts detail how flocks were so large they blocked out the sun, or took hours or days to fly over. The rhyme in the film references how a passing flock could result in weeks of feasting on pigeon pie instead of scraping by on poorer food. In only a single generation this seemingly inexhaustible population was brought to extinction. Had there been hunting seasons and enforced limits on hunting the species probably could have been preserved. The conservation efforts came too little, too late for this species. There have been other species that were brought to extinction by hunting and or habitat loss. These include the Carolina parakeet, dodo, great auk, and likely the ivory-billed woodpecker. Today other resources once deemed inexhaustible are being used at unsustainable rates by an ever increasing human population. If we do not pay attention now to managing both renewable and nonrenewable resources, many more plants, animals, minerals, water and other resources may become depleted or disappear in the future.

Materials Required

- Access to Internet for research
- Field trip to a water treatment plant
- Access to a natural area for a class field trip or independent study

Procedure

Watch the fifth and sixth chapters of the film. Ask the students for any initial responses to the content. Discuss the attitudes and practices of people toward the passenger pigeons when they were believed to be an inexhaustible natural resource. Are there any resources today that we deem to be inexhaustible but should be managed more sustainably now while there is no shortage? What are the success stories where management practices have changed due to lessons learned by the extinction of the passenger pigeon?

Identify natural resources people tend to take for granted because they believe they are plentiful. These may be renewable resources or nonrenewable resources. Examples may be fresh water, oil, lumber, or minerals.

Determine if the resource is renewable — like forests or fisheries, that if managed correctly can replace themselves over time— or nonrenewable — like minerals and petroleum, which once used up will be gone. Have students brainstorm and research how each resource can be managed so that it will be available for future generations.

Do a sample of trash and recycling bins on campus or have students take a survey of trash and recycling at home. Have the students research what materials are used to produce items used every day, particularly those that are thrown away. Petroleum is used to produce plastics; trees are used for paper products and animals and plants are raised and harvested, possibly utilizing food waste. Have students record for a week how many resources they use. Be sure to include water.

At the end of the week-long survey have a class discussion about how many resources each student consumed over that time. Brainstorm ways to reduce consumption by overall reduction, more thoughtful and deliberate use of resources, and recycling and reusing more resources. Have students research how consumption in the United States compares to other countries and cultures.

Have a discussion with the class or assign a research project looking at water use. While much of the Earth is covered in water, only a small percentage of that water is fresh and clean for use in drinking, agriculture and cleaning. Look at the ways each person uses water, and how that compares to other countries. Where in the United States is water becoming a more scarce and precious natural resource? How can each person reduce water consumption overall?

Assessment

Have students prepare questions for a guest speaker or field trip. You may want these turned in ahead of time for approval to make sure they are on topic and appropriate.

Collect the findings of the students on what resources they used in one week, and any responses about what they will do differently to reduce their use of resources.

Extensions and Adaptations

Arrange for a field trip to a water treatment plant, or invite a speaker in to talk with the students. See how water that is polluted is recycled for use as drinking water for the community.

Tour a local agricultural site and focus on use of water resources. Find out how farmers use water as sustainably as they can by watering at times of the day when evaporation is lowest, or by using soak hoses and other innovative irrigation practices.

Assign a creative writing assignment or art project where students imagine a future where a resource we consider plentiful and inexhaustible is now gone or severely reduced. How does this affect the lives of the generations beyond?

Begin or expand a recycling program on your campus. You can make this creative by hosting an art show with items made from things that would have normally been put in the trash. Recycling companies like Terracycle www.terracycle.com/en-US/ offer fundraising activities, recycling all manner of waste, and paying schools based on the amounts sent. Have students research the concept of "zero waste," which is discussed on the Terracycle website.

Have a class field trip or have students take a trip on their own time to a local natural area. Have students spend some time observing the natural world and journaling about their observations. This will give students a connection to wild places and direct observation of plants and animals not as resources, but as part of a local ecosystem.

Chapter Seven

The Web of Life

General Theme	All organisms are connected in the larger web of life. When you impact one organism there are unintended consequences to other organisms.
Lesson Objective	Observe the impact of one species on an entire ecosystem.
Time Allowed	60 minutes for the initial viewing and discussion. This lesson may take multiple class sessions for students to complete the observations then report their findings.
Location	Outdoors for observations of organisms.
Background Information	The extinction of the passenger pigeon did not just mean one species of bird disappeared from the land. Though we don't know exactly how, all the other species that the passenger pigeon touched in its life were affected, and there may be remaining ripples sent out through the web of life that are still felt today. Passenger pigeons were a force of nature. Their large flocks swooped into forest communities feeding in waves on mast and seeds. They roosted and nested in such large numbers to break limbs off trees and cover the ground in thick layers of droppings. A species of billions, the passenger pigeon had an inevitable impact on the species around it. Ecology is a relatively new study in science, but it has long been acknowledged by observation that plants and animals are connected more in a complicated web structure than a linear food chain. When you affect one strand in the web you tug on several others. This was true in the case of passenger pigeons, but biologists were not around to study this. In the film one scientist poses a speculative

theory about Lyme disease, and how deer and mice populations may have been affected by the dominance of passenger pigeons feeding on mast, or nuts. Mice carry a type of tick that also feeds on deer as well humans, thus transmitting Lyme disease to humans. Over a century ago, the theory goes, deer and mice populations that ate nuts would have been kept to manageable numbers, as masses of passenger pigeons would have been eating the bulk of this food. The extinction of the passenger pigeon would have resulted in larger deer and mice populations, as the feeding competition would have been gone. Higher populations of mice and deer may have led to more ticks and hence more Lyme disease carried by the ticks. Perhaps the multitude of passenger pigeons feeding on mast kept mice and deer tick populations in check. Perhaps there might be less Lyme disease in the world if we still had the passenger pigeon.

Materials Required

- Access to Internet for research
- Access to organisms to observe; this could be the school campus
- Journal for data collection — paper or electronic

Procedure

Watch the seventh chapter of the film. Ask the students for any initial responses to the content. Discuss how species are connected to each other in food webs and other natural connections.

Set up small group or individual projects to observe a particular species for a set amount of time — at least a week, but this could last through a semester or year if you have the time and the students become very interested and involved. Each student or small group chooses a species of animal or plant s/he can easily identify and that is accessible. Some choices may be tree squirrel, blue jay, robin, white oak tree, big bluestem grass, or garter snake.

Draw up a format for collecting data that is regulated each time. You may make up a template on the computer or have students set up a notebook that can be taken into the field. Data should include: time and date of observation; weather at the time of observation; location of observation; what other species interact with the study organism; how other species interact with the study organism; how does the interaction affect each organism? Some interactions can be positive for both organisms; some give an organism an advantage over another. Some may have no effect on the other and some are detrimental to both parties.

At the end of the assigned time for observations reconvene the class to discuss the findings. Students may want to share observations and interactions that were regular occurrences, or those that were out of the ordinary. After sharing data, steer the discussion to what would happen to the other observed organisms that interacted with the study organism, should that living thing be taken out of the situation. If the oak trees no longer grew, the acorns would not be available as food items. Leaves would not be food for insects that were in turn food for other predators, and the tree would not be available as a home for other species. What would the other species do to replace the oak tree or would they have to move on to find another suitable tree species to support their life cycle?

Assessment	Have students periodically turn in their journal of data over the assigned time. If students are having difficulty with data collection this gives you the chance to intervene and provide assistance along the way. Have the students create a physical or electronic presentation piece that can be displayed in the classroom or on a class website or blog.
Extensions and Adaptations	After doing the observation and data collection over the assigned time, have the students or small groups prepare a presentation to give to the class. They can include charts of numbers and types of organisms observed, how the observations changed over time or with time of day or weather conditions, photos and videos of organisms being observed, and/or audio recordings. If your class has access to technology, like ipads, you can have the students use this technology to aid in their observations and presentations. Research the study organism online with reputable sources where data has been verified. Students can compare their findings to other research done on the same organisms. Report on any differences founds, and why those differences have occurred. Have students present their findings in a scientific research paper format. Invite a local wildlife specialist to talk with the class about native species and their role in local ecology. Take part in a local habitat restoration project as a service learning piece.

Chapter Eight

Strategy Meeting

General Theme	There are connections to be made between the extinction of the passenger pigeon and to making a difference in conservation issues today.
Lesson Objective	Identify a conservation issue personally important to students and work to make a difference.
Time Allowed	60–90 minutes for the initial viewing, discussion and dividing the work. This lesson will take multiple class sessions to identify a cause, set up committees to do the work, and set up a public event.
Location	Indoors or outdoors, depending on the issue chosen
Background Information	The extinction of the passenger pigeon is significant in its timing. Because the species was so depleted and well-documented, the death of Martha in the Cincinnati Zoo was pinpointed as the loss of the final passenger pigeon alive on earth. This extinction of a species, once so numerous it was thought impossible to ever disappear, sparked conservation efforts that rippled around the world. The group that met for the strategy meeting had an important question to answer — why is this issue important to me? If a person does not have a personal connection to an issue they will not pursue a solution. There are many issues, environmental, social, political and more, that affect people. Investigation into your own community will reveal issues that affect the daily lives of people throughout the community and region. By identifying one issue to address as a group you have a greater chance of making an impact on the larger community. The challenge is to find an issue that each in the group personally identifies with, and to find a way to spark a personal connection with others in the community so the issue can be addressed. If you find an issue that people want to take personal responsibility in solving, they will become new advocates to help address the issue further. For the passenger pigeon, the lessons learned that would have prevented its extinction came too late. Today there are issues that can be addressed that we can act on. We can still do something if we care about it.
Materials Required	■ Access to Internet for research, social media and surveys ■ Materials to set up a hands-on educational event ■ Site to hold the hands-on educational event

Procedure

Watch the eighth chapter of the film. Ask the students for any initial responses to the content. What are some species or other environmental areas facing degradation in your region that people seem to be ignoring? Are there environmental issues in your region that people simply do not care about because they feel they do not impact them personally?

Brainstorm with the students about issues that are affecting the community. They may be environmental or social. If possible choose one that the class can adopt as an issue everyone cares about.

Draw up a plan to address the class issue in the community. Break the class into small groups to act as committees, each tackling one aspect of the problem and how to address it. Committees may include those that educate the community, advertise public events related to the topic, secure sites to hold education sessions, or contact local lawmakers and officials to address the problem.

Once a week have the students report the progress in their committees, and to meet as a class to see what work needs to be done. Set up a timeline to have an event to educate the public about the chosen topic and the challenges to be addressed.

If the cause is school-related, the final event could be a work day or assembly about the issue. If the issue is broader, a community event might be more appropriate. The event could still be held at the school, as this site may be easier to secure than others.

The goal for the class is to try to take their enthusiasm for the issue and infuse this in the larger community. For this to happen, having hands-on activities is an important aspect of the event. Ideas include doing restoration work in a local conservation area, cleaning up a city park or neighborhood, setting up a community garden in a food desert area of the city, or helping build a new enclosure at a local wildlife rehabilitation center.

Assessment

Have student committees turn in progress reports regarding setting up an event to address the issue.

Take surveys of event participants regarding their attitude about the issue after attending the event.

Track community response to the issue by using a free electronic survey application.

Extensions and Adaptations

Start a social media campaign to gather information about the issue and develop a following to help address it. Track this with analytics provided by the social media site. If needed, crowd source funding to help as necessary.

Students may develop internships with local non-profit organizations or government agencies to address the problem more deeply

Chapter Nine

The Wisconsin Nesting and Shooting

General Theme	Large nestings of passenger pigeons gave hunters opportunities to take large amounts of both live and dead birds. Using historical records, maps can be made to show just how large these nesting events were.
Lesson Objective	Map the areas of the last large nestings of passenger pigeons.
Time Allowed	60–90 minutes for the initial viewing, discussion and mapping.
Location	Indoors.
Background Information	The period from 1871 to 1882 is an important one in the history of the passenger pigeon because we can see how rapidly the birds decreased. The largest nesting on record occurred in 1871 in central Wisconsin; the last big nesting occurred in Petoskey, Michigan in 1878. The last time birds nested in colonies of over one million birds occurred in Pennsylvania and Wisconsin in 1882. Because of increased communication and intensification hunting efforts, these last nestings tended to be well-documented (the exception are nestings in Ontario where little is known). Some present-day scientists theorize that the species may have also undergone behavioral changes and abandoned nesting sites due to relentless hunting. This gave flocks little refuge to nest and raise young, so they were reaching a point they could not replace numbers that were being lost each year. Some of the statistics included in the film are: ■ The 1871 Wisconsin nesting covered an area the size of 37 Manhattan islands, 850 square miles. ■ Pigeon hunters would use nets to capture hundreds of birds at a time and used a tethered bird called a "stool pigeon" to lure unsuspecting flocks to the nets. ■ Birds were killed, packed in barrels and sent to feed people in urban areas — for the Wisconsin nesting 100-200 barrels with 300 pigeons each were sent each day to market for 40 days. ■ Live pigeons were shipped for use as targets in shooting competitions, and over 500,000 were killed every year at the height of popularity of this sport in the mid-1800s. ■ Hunting clubs were a source of conservation efforts with club members attending some of the last nesting sites in an effort to enforce existing laws restricting hunting of passenger pigeons.

Materials Required

- Access to Internet for research
- Maps of Wisconsin: topographical, historical to 1871, and modern
- Maps local to your area
- Pencils, pens, rulers and highlighters to measure and mark the maps
- Any art materials needed for extensions

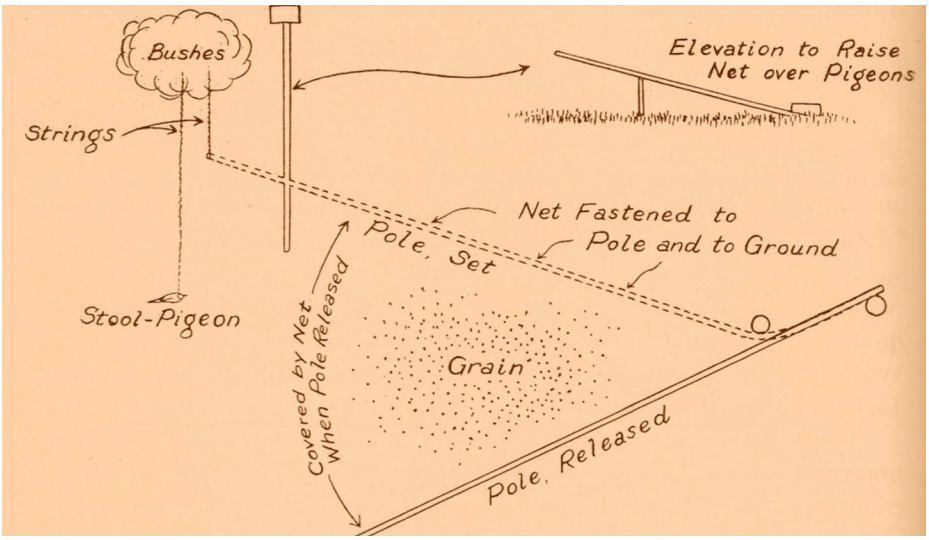
Procedure

Watch the ninth chapter of the film. Ask the students for any initial responses to the content. Many statistics are given about methods used to kill and capture passenger pigeons, how many birds were harvested, and the attitudes of people about passenger pigeons. What are student reactions to these aspects of the bird's history?

The statistics give one picture of the scope of hunting of the passenger pigeons. To get a feel for how large the flocks were in the large, late nestings in the history of passenger pigeons, have students do a mapping activity for a visual effect.

Using the Quincy Bluffs reference given in the film as a starting point, map the 1871 Wisconsin nesting site. In the spring of 1871 approximately 136 million passenger pigeons were concentrated in an area about 850 square miles. Using a map of Wisconsin, figure this area and mark it on the map. Compare between a topographic map that shows primarily surface features, a historical map that indicates cities present in 1871 and a road map that shows modern cities. How many people occupied the same space then and now? You may have the students divided into groups so each group is working with a different map.

Post the maps in the classroom and have each group present their map and how the nesting affected the areas impacted on the map. How do the areas of impact differ in interpreting topographic, historical and modern maps? Have students compare all the maps regardless of the one they were working with directly. What are the feelings evoked by comparing the impacts on different maps? NOTE: The actual map of the



1871 passenger pigeon distribution is shown on page 132 of Joel Greenberg's book, *A Feathered River Across the Sky: The Passenger Pigeon's Flight to Extinction*. The shape is like a tipped back letter "L." You can reference this for students to see what the actual nesting looked like.

Transfer the map of the Wisconsin nesting to a local map. How would your local area be impacted by a nesting of passenger pigeons this size now and historically?

Assessment

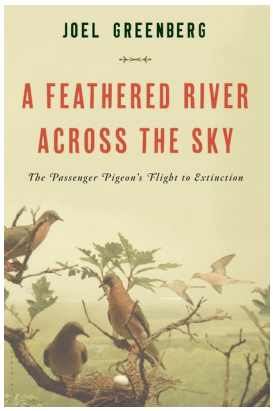
Look at the accuracy of the student measurements that show the nesting site on the map.

Assess how accurate students portray their roles in the historical debate.

Extensions and Adaptations

Use the statistics cited in the film to come up with other visual representations of a passenger pigeon nesting site. These may be origami pigeons, available at Project Passenger Pigeon (passengerpigeon.org) with one origami bird representing 100 actual birds, a mural created on a roll of paper that can be hung in a hallway, or an electronic representation of what 136 million birds would look and sound like in one area.

Set up a debate between different sides of the passenger pigeon conservation efforts that is historically accurate to the late 1800s. Students can represent members of conservation clubs that used live birds as targets at shooting competitions, pigeon dealers who sold birds at market, local residents who made good money from occasional nesting and roosting events, or farmers whose land and crops were impacted by large numbers of roosting birds. Using Joel Greenberg's book, have students research actual people they would be representing, dress appropriately, and stage a class debate with a moderator. You may include a modern perspective of generations deprived of experiencing passenger pigeons in life by the actions of those in the past.



Chapter Ten

Oceans and Sharks in Peril

General Theme	Passenger pigeon populations were decimated by direct hunting and secondarily, by habitat loss, the very same pressures that the world's fisheries face today. Passenger pigeons filled a role as a keystone species that influenced many other organisms in their habitats. Sharks fill that role in oceans and are facing the same pressures once faced by passenger pigeons. Look at the role of keystone species to understand their importance.
Lesson Objective	Understand what a keystone species is, how it affects the rest of the ecosystem it inhabits, and investigate what happens to an ecosystem when the keystone species is eliminated.
Time Allowed	60–90 minutes for the initial viewing, discussion and project construction. Additional class period for reports and mapping of affected species is recommended.
Location	Indoors
Background Information	A keystone species is a plant or animal that plays a unique and crucial role in the way an ecosystem functions. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether. All species in an ecosystem, or habitat, rely on each other. They are named after the keystone at the top of an arch. The rest of the stones rely on the keystone in the middle to hold the whole arch together. When the keystone is lost or damaged, the rest of the arch will fall apart. Though they were not scientifically studied at the time, Passenger pigeons filled a role as a keystone species for portions of Eastern North America as they consumed such large amount of mast. Their feeding, roosting and nesting in such large

numbers affected the rest of the ecosystem where they were present. When passenger pigeon numbers diminished and then disappeared, the systems that had developed alongside the passenger pigeons were changed. The trees still produced large amounts of mast, but pigeons were no longer consuming the mast. Other animals came in to feed on the mast, but never in the numbers as the pigeons did. The forest communities that were changed by periodic roosting and nesting that left copious amounts of droppings now lacked this occasional influx of nutrients and clearing of trees. This would change the overall health and make-up of the forest communities.

Sharks have existed on Earth for 400 million years. They are an apex, or top, predator that affects all of the life in the ocean. Currently approximately 100 million sharks each year are being harvested. Many are caught, their fins cut off while alive, and the wounded shark is released back in the ocean to die. This harvest is unsustainable. The effect of removing shark species is unknown, but as a keystone species it would have impacts far beyond those animals that are currently prey animals. As was the case of the passenger pigeon, humans are now acting as top predator removing a keystone species from its place in the ecosystem.

Materials Required

- Access to Internet for research
- Paper or board to draw an arch with a keystone
- Foam blocks if you wish to build an arch
- String, photos and artifacts representing species affected by passenger pigeons and shark species to map in the classroom.

Procedure

1) Watch the tenth chapter of the film. Ask the students for any initial responses to the content.
2) Introduce the concept of keystone species to the group. If you can, have a picture of an arch with a keystone at the top so it is easier for the students to grasp the concept.
3) Make an arch for the passenger pigeon. Have an arch made up on large butcher paper, on the board in the classroom, or build an arch with foam blocks.
4) Place the passenger pigeon in the keystone block of the arch.
5) Research and brainstorm species of plants and animals that would have been affected by the feeding, roosting and breeding behaviors of the passenger pigeon. Place these organisms in the blocks that are supported by the keystone.

Do steps 3-5 for sharks in today's oceans.

Break the class into small groups and have each research current behavior and distribution of species that were affected by the passenger pigeon and are affected by sharks.

Later in the period or in a separate class period have each group give a report on how their species was affected by the passenger pigeon's extinction, and how listed species are affected by the decline of sharks in the ocean.

Assessment	Check for accurate species interactions. Participation in group service learning project.
Extensions and Adaptations	Place a picture of a passenger pigeon and a shark on opposite walls of the classroom. Place pictures of other species affected by each on their respective wall. As the students give their reports, have them run string between the featured species and all the other species it affects. This will give a visual representation of how all species are connected in an ecosystem. Find a local species that is threatened or endangered. Have the students research what is causing the species to decline. Do the mapping exercise with species that are affected by the loss of the local species. Find a local conservation group involved in protecting local species and/or habitats and work with them on a service project to help protect the local species.

Chapter Eleven

Wyalusing Monument and Extinction Theory

General Theme	The passenger pigeon population suffered a collapse in numbers that led to the extinction of the species in a relatively fast time frame. We don't know the precise cause, but there are several possible causes for its extinction.
Lesson Objective	Investigate stresses on the passenger pigeon population in their last years and hypothesize what cause or combination of causes led to their extinction.
Time Allowed	60–90 minutes for the initial viewing and discussion. Additional class periods are recommended for collecting and presenting evidence.
Location	Indoors
Background Information	Passenger pigeons were once the most numerous species of bird on the planet. In the film they are described as being a "volume of concentrated life." The question is how this prolific and plentiful species went from billions to none in a matter of a few decades. The film highlights the 1947 monument to the passenger pigeon commemorating the shooting of the last wild bird in Wisconsin in September of 1899. This was only 21 years after the largest nesting of passenger pigeons on record took place in Wisconsin in 1878. There are several stresses that contributed to the demise of the passenger pigeon as a species. Whenever they nested or roosted in large flocks, the birds were shot and netted in large numbers by both locals and professional pigeon hunters. Technology had improved to the point that people not only knew where passenger pigeons were located, but they could also get there quickly to take advantage of the bounty. It is theorized in the film that after the Civil War large numbers of nesting or roosting passenger pigeons were harassed so frequently that they became too skittish to reproduce. The theory posits that without being able to replace their numbers, passenger pigeons reached a tipping point and the species was unable to recover. Conservation efforts implemented by concerned citizens came too late for the survival of the species. Looking at all the stresses that were endured by the passenger pigeon, oversee a class investigation to find out what a possible tipping point might have been and how this lesson can be used in modern conservation efforts to prevent future extinctions.

Materials Required

- Access to Internet for research (passengerpigeon.org and other sites)
- Photos or signs for each cause of extinction forensic station
- Copies of the essay "On a Monument to the Pigeon" by Aldo Leopold
- Possible access to costumes and stage for dramatic presentation
- Possible use of local gallery or area in the school for essay and art/photo contest
- If needed, judges for essay and art/photo contest

Procedure

Watch the eleventh chapter of the film. Ask the students for any initial responses to the content.

Set up the classroom or space with investigation stations for each possible cause of the passenger pigeon extinction. These include: improved communication technology, improved transportation, more effective hunting techniques, increased urban populations requiring cheap protein sources (increased demand for passenger pigeon meat), habitat loss by human activity in forests used by passenger pigeons for food, nesting and roosting.

Read the essay "On a Monument to the Pigeon," from Aldo Leopold's *A Sand County Almanac and Sketches Here and There,* either together in class, or have students read it before the session begins. Have a discussion about why Leopold is so passionate about the extinction of the passenger pigeon. What are the students passionate about that they have lost or are in danger of losing?

Divide students into forensic teams to investigate one of the historical causes of the extinction of the passenger pigeon. Focus on local causes if possible, particularly if there were major roosting and/or nesting events in your area. Students should meet a few times to collect evidence and make a case to the rest of the class about why their assigned cause or stress was important in the extinction and how it could have been mitigated.

After all evidence has been presented have a class discussion and/or debate about what the students believe led to the extinction. As pigeons were so widespread it is likely a combination of several causes made the extinction inevitable.

Assessment

Presentation of evidence of extinction by small groups

Essays about loss and potential art or photo projects about loss

Extensions and Adaptations

Have an essay contest where students write about something they are passionate about that they have either lost or cannot imagine living without. If possible, involve local media so essays can be published. You can have a photo or art contest alongside the essay contest. Talk to local art galleries or host the art and essay contest in a show at the school. Essays can be displayed alongside appropriate photos or art. Students can read winning essays live or record them to be played at the show. Get local sponsors involved so scholarships or prizes/gift cards can potentially be given to winning pieces.

Present the final display of evidence as a drama set in the era of the late 1800s when passenger pigeons were still around, but their numbers dwindling. You may want to enlist the help of your school's drama department or debate coach to help moderate the debate and presentation of the evidence. Students can take the role of local residents on both sides of the conservation debate.

After the causes of extinction have been presented and debated, present conservation efforts that were in place in the late 1800s/early 1900s and were enacted as a result of the passenger pigeon extinction. These include protection of species, game management practices included in hunting practices and habitat protection. Investigate how these might have been able to prevent the extinction of the passenger pigeon, and how they have helped species currently under threat.

Chapter Twelve

Martha at the Zoo—Yesterday and Today

General Theme	Zoos have changed their main function over time. At the time of the passenger pigeon, zoos served as menageries, displaying many exotic species. Today zoos serve to help conserve wildlife, preserve DNA of threatened and endangered species, and advocate for habitat conservation.
Lesson Objective	Learn about the changing role of zoos over time and what role modern zoos play in local and worldwide conservation efforts.
Time Allowed	60–90 minutes for the initial viewing and discussion. Additional class time required for zoo staff to talk with the class or for a field trip to a local zoo or other wildlife facility.
Location	Indoors or outdoors (if zoo visit)

Background Information

Passenger pigeons were unlike many species of current concern; they could be kept and easily bred in captivity. This was never done in earnest because there were so many that few people believed they would become extinct. The film mentions that Professor Charles Otis Whitman of the University of Chicago kept and bred various pigeon species, including passenger pigeons. But Whitman was not breeding passenger pigeons to save the species. In 1902, a female bird was sent by Whitman to the Cincinnati Zoo, where she was named Martha. Her mate George died in 1911, but Martha lived a few more years. On September 1, 1914, perhaps at around 1 pm in the afternoon, Martha, the last known passenger pigeon alive in the world, died in the Cincinnati Zoo.

At the time of the passenger pigeon extinction zoos served a much different role than they do today. Zoos were largely entertainment venues that housed exotic species at which people would marvel. Because George and Martha were the last of the known passenger pigeons they fit this bill. Then Martha became famous for being the last of her species. After her death, her body was encased in a 300 pound block of ice and transported by train to the Smithsonian Institution in Washington D.C., where she was on display for decades. She was brought out of storage and put on display for the 2014 centennial of the extinction.

Modern zoos have changed from simply being entertaining menageries of exotic species to functioning as a storehouse of endangered animals and as centers for conservation education. Zoos store DNA of threatened and endangered species and act as research facilities for ways of conserving and restoring species in the wild. While zoos are still controversial to many, they are a force for habitat conservation and restoration so species may be released into the wild. Check with your local zoo about their conservation efforts.

Materials Required

- Access to Internet for research
- If possible, take a trip to a local zoo or arrange a zoo staff person to give a presentation in class

Procedure

Watch the twelfth chapter of the film. Ask the students for any initial responses to the content.

Students may feel upset about Martha's death and even cheated that they are unable to see passenger pigeons because of the actions of people in the not so distant past. This is a normal reaction. This emotion can be channeled to enact change in situations today.

Set up a time to have staff from a local zoo visit the classroom and talk about what conservation efforts are being done at their facility, or arrange a behind-the-scenes tour of your local zoo to see these efforts firsthand.

Students can choose a species that is being researched and/or protected as a result of actions at the zoo. Find out what actions are being taken worldwide, in concert with any local efforts.

If no zoo is nearby talk to a nature center, wildlife rehabilitation center or conservation branch of the local government to find out about local conservation efforts. Most of these groups have volunteer opportunities for students who want to take part in these efforts. Students can give a presentation on their volunteer work to the class.

The ticking of the clock in the soundtrack of the film hints that while little conservation effort was made for passenger pigeons, the time is now for current endangered species and habitats of concern. Turn the negative emotions of your students into positive efforts directed toward your local community.

Assessment

Presentations of efforts beyond your local community in species and habitat conservation

Volunteer hours logged at local conservation groups

Extensions and Adaptations

Have students design an enclosure and habitat for local species of concern. It can be done as a diorama, an app, computer simulation, or any other method that fits your technology needs.

Hold a school or community fundraiser for your local zoo that highlights its current conservation efforts. Your magination and those of your students are the only limits. Perhaps hold a penny drive to stop ivory poaching, or car wash for prairie dog villages.

Chapter Thirteen

A Modern Conservation Ethic and Extinction

General Theme	The legacy of the passenger pigeon extinction is heightened awareness of environmental issues, and more thoughtful and deliberate use and conservation of natural resources worldwide.
Lesson Objective	Understand the change in mindset about natural resource use before the passenger pigeon extinction and after the event. Find local ways to be involved in conservation efforts.
Time Allowed	60–90 minutes for the initial viewing and discussion. Additional class time required for a conservation expert to talk with the group, and to research and present information on local threatened and endangered species.
Location	Indoors and outdoors (build and monitor schoolyard habitat).
Background Information	The death of Martha, the last passenger pigeon, marked a turning point from a mindset that viewed nature as an expendable commodity to the rise of a modern conservation ethic. If the most abundant bird in the world could be made extinct by human action, perhaps other seemingly infinite resources could be depleted. This change did not come overnight, but people began to change their ideas about land and natural resource uses. This is the era that began to see large natural areas being set aside as national parks, for future generations to enjoy. Naturalists of this time who called for concerted conservation efforts included John Muir, Aldo Leopold and Theodore Roosevelt. Conservation groups like the Audubon Society became active on the federal and state level. One hunting group founded in 1927, and later became Ducks Unlimited, saw conservation of land and resources as a way to ensure that hunting would be viable now and in the future.

The extinction of the passenger pigeon is a cautionary tale; seemingly unlimited resources can be depleted with careless use and no foresight for future generations. Legislation like the Endangered Species Act of 1973 ultimately owes its existence to

the public reactions following the extinction of the passenger pigeon and the near extinction of bison.

Materials Required

- Access to Internet for research
- Copies of "The Land Ethic," by Aldo Leopold
- Copy of Federal and State Threatened and Endangered Species
- Arrange for local conservation expert to talk with the class
- Site and materials for schoolyard habitat (optional)

Procedure

Assign students to read Aldo Leopold's essay, "The Land Ethic," before viewing this segment of video. Watch the thirteenth chapter of the film. Ask the students for any initial responses to the content.

Discuss what students do in their daily lives to conserve natural resources. Talk about what people have done in the past regarding these resources and why they may have done so. Discuss how the extinction of the passenger pigeon may have prompted Leopold to write the essay and how it reflects changing attitudes to natural resources.

Post or distribute the list of Federal and State Threatened and Endangered species. www.worldwildlife.org/species/directory?direction=desc&sort=extinction_status How many are students familiar with? What species are present in your community from this list?

Have students choose one species to research for its habitat needs, its interaction with other species, and other interesting aspects of its life. The students should also research what conservation efforts are underway to conserve the species and/or its habitat.

Students can present their findings to the class as a poster display or PowerPoint presentation.

Assessment

Participation in class discussion

Presentation of information on local threatened or endangered species

Extensions and Adaptations

Invite a conservation expert from a local not-for-profit or government agency to class to talk with students about local conservation efforts to help threatened and endangered species. There may be volunteer opportunities for students to work directly with these groups to conserve local species.

Set up a schoolyard habitat. Many states have grant money available and your local nature center may have staff and expertise in setting these up. Depending on your site you may think about installing a prairie planting, rain garden, arboretum, or whatever else fits your local climate and space in the schoolyard. Monitor the site for species making use of the habitat.

Chapter Fourteen

De-extinction and the Passenger Pigeon

General Theme	There is debate concerning an ambitious new movement that needs money and resources that uses DNA samples to bring back once-extinct species, while conservation efforts continue to focus on conserving still living threatened or endangered species.
Lesson Objective	Understand each side of the de-extinction/conservation debate, and be able to see the validity in either opinion each student holds.
Time Allowed	60–90 minutes for the initial viewing and setting up of debate teams. Additional class time required for research and having a debate on the merits of both sides of the debate.
Location	Indoors
Background Information	In the spring of 2013, Ben Novak began working with an organization called Revive and Restore to work on a strategy to bring back the passenger pigeon. It was called De-extinction. The theory is that scientists can take DNA from passenger pigeon specimens and integrate this into their closest living relative, the band-tailed pigeon, and create a closely related hybrid. A tissue sample the size of a pinhead taken from a museum specimen has the complete genome of the passenger pigeon. The idea is that if this can be successfully done with passenger pigeons, then perhaps it could be done for other recently extinct species. Also, the DNA extraction methods could help repopulate species on the brink of extinction. The other side of the debate believes that extinct species should remain extinct. This side argues that scarce funds would be better spent for conservation efforts of threatened and endangered species and their habitats instead of funneling large amounts of funds into bringing back extinct species. If the two efforts were competing for funds, it is feared that interest would lean toward the more exotic de-extinction efforts and hurt current conservation projects. Also, some argue that if it is possible to bring back extinct species, at least in some hybrid form, would the public

lose the impetus to save species in peril? Might sushi lovers argue that scientists can always bring back bluefin tuna, so why not eat as much as we want, even if it leads to its extinction?

Some argue that Novak's efforts would not result in a real passenger pigeon anyway. It would always be a hybrid of the passenger and band-tailed pigeon. We could never (nor perhaps should we) bring back the forces of nature that were the massive sky-filling flocks of passenger pigeons. Given the importance of agriculture in the modern economy, as well as commercial aviation, it is also unlikely that there would be public support to bring back the passenger pigeon en masse. On the other hand, if a hybrid flock was recreated, band-tailed pigeons live in smaller colonies than passenger pigeons once did, and would never be a sky-filling phenomenon. And the hybrid flock would provide a compelling glimpse at a once-extinct species that current generations have been denied.

Materials Required

- Access to Internet for research
- TED Talks recording of Ben Novak's and Stanley Temple's de-extinction talk and other current online resources on the topic. (Complete Novak and Temple talks viewable at billionstonone.com > de-extinction)

Procedure

Watch the fourteenth chapter of the film. Ask the students for any initial responses to the content.

Discuss in class the pros and cons of de-extinction. Proponents of de-extinction could argue that recreating lost species is the right thing to do, and that the DNA research can help expand the gene pool for current species with too few individuals to reproduce, like the black rhino. If we can bring back lost species, why not do it? Those against the de-extinction could argue that it could distract from funding current conservation efforts, funding for saving species that are currently on the brink of extinction, or for pure research.

Have students decide which side of the debate they support, or which they would like to argue for. Each group will form a team and spend time researching current information online and through local organizations.

Reconvene after a set amount of research time and hold a class debate. You can moderate the debate yourself, have students moderate, or bring in the school debate coach.

Assessment

Participation in class discussion

Presentation of information in class debate

Extensions and Adaptations

Instead of a traditional debate, make the project more theatrical. Have students act as different stakeholders of the debate. Teams could include students acting as research scientists, wildlife conservationists, farmers, USDA foresters, de-extinction advocates, local indigenous people, urban planners, and others that are relevant to the debate and your location.

Involve historical voices in the debate, such as hunt club members that would like passenger pigeons to return, indigenous people, woodlot owners, and others.

Chapter Fifteen

A Mural in Downtown Cincinnati

General Theme	Art was used as a way to raise awareness of the 100th anniversary of the passenger pigeon extinction in the city where Martha died. Public art is a powerful way to raise awareness of issues in both the artists participating and those who view the art.
Lesson Objective	Experience the power of art to educate and motivate desired actions and results.
Time Allowed	60–90 minutes for the initial viewing and artwork in class. Additional time for any larger art project in school or in the community.
Location	Indoors and potentially outdoors
Background Information	In honor of the 100th anniversary of the extinction of the passenger pigeon, a mural was commissioned in Cincinnati, Ohio to recreate a painting by artist John Ruthven. Ruthven is described as the 20th Century Audubon. His mural is featured in the film, and highlights a flock of passenger pigeons "led" by Martha, the last passenger pigeon. The mural is set in the city of Cincinnati to bring the message of the extinction of the passenger pigeon to a large population. Many young people were involved in painting the mural and the act of creating the art gave them appreciation and empathy for the passenger pigeon.
Materials Required	■ Access to Internet for research ■ Artwork to enlarge for a chalk mural ■ Photos and drawings of passenger pigeons to post in the room ■ Artwork of other extinct species to post in the room ■ Chalk and/or other art supplies
Procedure	Watch the fifteenth chapter of the film. Ask the students for any initial responses to the content. Post the pictures of passenger pigeons and other extinct species in the room. Ask students for their impressions of the art and the animals that have gone extinct. Have students each study one of the pictures and if possible, draw it to the best of their ability. Have students look up information about the animal they are studying. Afterwards ask the students if their impressions had changed about the animal each had studied. If possible, in a separate class period, use a portion of a schoolyard or parking lot to set up a chalk mural project. Choose a piece of art depicting the passenger pigeon.

Set up a grid on the artwork to enlarge it to scale for the project. You may enlist the help of an art teacher with this portion of the project. Over lunch periods or other time the students are able to be out of class have students each take a piece of the grid and recreate the picture in large scale. You may be as detailed as you would like. This may be an all-school project if you like. Take a photo from above, perhaps from a higher window, tall ladder, or the supervised use of a drone.

If doing a large-scale art project is not feasible have each of the students display the artwork they recreated in class in a way they prefer.

Assessment

- Participation in class discussion
- Participation in art project (you do not have to assess on art ability)
- Discussion of changed attitudes after taking part in an art project

Extensions and Adaptations

Have a school-wide art contest featuring the passenger pigeon on the anniversary date of the extinction of the passenger pigeon. Invite the public to view the art and have local conservation organizations featured.

Work with local artists and/or galleries to have a community-wide project. This may involve pleinaire contests highlighting local natural beauty, a public art piece, or other artistic media such as dance, film and/or music. Hosting the event on or around the extinction date would help raise awareness of extinction and other conservation issues.

Chapter Sixteen

Species Importance and Joel's Favorite Place

General Theme	Ecology involves many species working together to support a complex web of life that includes people; how you view your relationship to the rest of the organisms depends on your sense of place.
Lesson Objective	Develop a sense of place about the local ecosystem and learn to appreciate the roles of all the other plants, animals, fungi, soil, water and other components that make up the local ecology.
Time Allowed	60–90 minutes for the initial viewing and discussion. Arrange a separate 60-90 minute class period for the initial journaling assignment. A weekend day is best for a bioblitz that would garner the most involvement.
Location	Indoors and outdoors
Background Information	Creating and sustaining a community is a large theme of this chapter of the film. There are many supporting members of all communities explored here from the ecological communities that involve everything from plants, animals, soil, water and more, to people in many aspects of society working together to preserve wild places. Some of these highlighted at the Illinois Beach State Park are the park users, Illinois residents who pay taxes, the Illinois Department of Natural Resources, and local forest preserve districts and their employees.

We are all here, be we humans, other animals, fungi, plants or any living thing, because of a network of other living things. That is as true for ecological as well as social communities. It is important to keep all the pieces intact for the community to flourish.

Joel Greenberg's connection to the Illinois Beach State Park is due to its natural beauty, the species it supports, and his emotional response to the place. The ability to connect to a particular place is present in all people. It may be a place you were raised, a place that is special due to a personal relationship, or place that produced a deep emotional response. People have both good and bad connections to places, and this unit will focus on the positive personal connections.

Materials Required

- Readings from selected authors that describe places dear to them. These may include Ralph Waldo Emerson, Aldo Leopold, Sigurd Olson or other local favorites. Ask a local librarian for suggestions.
- Sticky notes, pen and twine
- Outdoor place for students to have time to journal

Procedure

Watch the sixteenth chapter of the film. Ask the students for any initial responses to the content.

Have a class discussion about the role a community has on the different aspects of their lives. You may start with ways students and faculty support each other in the classroom, how all people involved in the school and district work to support each other, and expand to the larger local community. Identify different elements of the community. Write these on the board or post them on sticky notes around the room. Use a ball of twine or string to connect which parts of the community rely on the other elements. You will likely end up with a detailed web of many pieces interacting and supporting other elements of the community. Remove one part of the community and see what happens to the rest of the elements.

Have students think about their place in the local community. Together in class read an excerpt from an author about his or her sense of place. Discuss how sense of place affects how one feels about the local community. Students from a different state, or particularly students from other cultures, will have interesting insight on the local community, unlike those born and raised in one place.

Assign students to read an author's insights into sense of place, either from a provided list or one chosen by the student. Have students begin a journal with their impressions of that reading.

In another class session, take time to go outdoors. Have each student choose a place in the schoolyard where each can be alone with their thoughts. Assign a journal prompt to get students thinking about a sense of place, about a physical place in their present lives. Prompts may include:

- "I like this place because..."
- "I hear and see _____"
- "I would like to live _____ because..."

Students may take these prompts or move in a different direction.

Bring the group together after about 15 minutes to discuss what happened while they were in their place. What experiences did the students have? Students should decide on a place of their own and visit it several times in the next week, month, or other time period appropriate for your class. Students should journal in their place and take note of physical features, changes over time, plants and animals, emotions they feel in that place at particular times, and other appropriate responses.

Meet again at the end of the designated time to discuss how students' feelings changed over time when they were in their special place. How does these feelings affect their sense of place in the larger community?

Assessment

- Participation in class discussion
- Completion of journal work

Extensions and Adaptations

Include journal prompts about how the place students choose might be different if they were alive in the era of the passenger pigeon. What would their feelings be toward the large flocks?

Coordinate a bioblitz of the schoolyard or other accessible area, preferably a natural area near the school. A bioblitz brings together professional scientists and interested citizens to take a survey of all the living things in one area. Ideally a bioblitz is to be done over a single 24-hour period to take account of diurnal (active during the day), crepuscular (active at dawn and dusk) and nocturnal (active at night) organisms. You can work with your local natural resources representatives to find scientists. The bioblitz can be done in the school, or involve the larger community.

Chapter Seventeen

Challenges, Success Stories and the Future

General Theme	The lasting legacy of the passenger pigeon extinction is a growing awareness that human activity has a strong impact on life on the planet, and human actions can be both good and bad for the well-being of the earth. We have caused and continue to cause species to go extinct, but we have also learned from past mistakes and have made great progress in conservation efforts.
Lesson Objective	Have a hopeful view that humans can work for the good of species and habitats and their conservation; we have done it in the past, and there are local efforts students can take part in to continue those good works.
Time Allowed	60–90 minutes for the initial viewing and discussion. Additional class time for presentation of findings and ways to protect and preserve species.
Location	Indoors
Background Information	We are currently living in a time when human activity is causing extinctions of more plants and animals than ever before, and unlike people alive when the passenger pigeon disappeared, we cannot claim the excuse of ignorance. Nonetheless, people have had positive impacts on the conservation of many plant and animal species, and we are able to replicate this. The legacy of the loss of the passenger pigeon and the lessons we should have learned have not always been heeded. As a species, humans still needs to deal with population growth, responsible and sustainable use of resources, and the limitation of technologies that do harm to the environment.

There are conservation success stories. Whales were once hunted to near extinction, but technologies changed and whale oil ceased being a sought-after worldwide commodity. Over a century later, nations united to create a moratorium on whale hunting, and whale populations are rebounding. Sharks are in this precarious place today. If we can overcome negative feelings toward sharks perhaps this can be changed for them as well.

The sandhill crane was severely threatened in the 1930s. Aldo Leopold wrote "A Marshland Elegy" as if the species would be extinct in the near future. Because of successful conservation efforts sandhill cranes are now the most plentiful crane species on earth. The lesson of once endangered species that have successfully rebounded is that we do not have to accept extinction as inevitability. Small steps taken by many people can add up to significant change, and one impactful way to enact change is by consumer action, when people decide not to buy a product that is leading to the destruction of a species. We can take steps to change attitudes and actions for conservation.

Materials Required

- Access to Internet for research
- Copies of "A Marshland Elegy," by Aldo Leopold
- Recordings of sandhill crane calls and videos of their courtship dance
- Space for presentation of information by the students

Procedure

Watch the seventeenth chapter of the film. Ask the students for any initial responses to the content.

Discuss with the students about their feelings about what can be done to preserve species and habitats of concern today. Read, "A Marshland Elegy" with the students and discuss the comeback of the sandhill crane. You may want to include the work that the International Crane Foundation is doing helping worldwide crane species recover by restoring native habitats and by working with people in areas where cranes live to change attitudes and actions.

Have students research endangered species both locally and worldwide. Have each student choose a species on which to focus. Students should research the concerns his/her species faces, ways to save the species and efforts that are underway to help preserve and conserve the species. Ideally the chosen species chosen will be emotionally important to each student. As they are deciding on a species have each student think about something in nature that gives them pleasure, then have them imagine how diminished their life might feel without it.

At another class session have students present their findings. This can be done as oral reports, poster displays, PowerPoint presentations, or other appropriate media.

Choose a local species of concern and focus on ways to conserve and preserve it. Arrange a day with a local conservation group to work on habitat restoration and/or community education.

Assessment	Participation in class discussion Presentation of information on local threatened or endangered species and ways to conserve and preserve them Participation in class project focusing on a local species of concern
Extensions and Adaptations	Stage the presentation of findings of the featured species as a public event aimed at educating the general public. You may want to work with a local nature center to coordinate this. If students are very passionate about particular species you may channel this into a more public campaign. Students may want to write letters to a local paper, arrange a public education campaign, work with local media to highlight the concerns and preservation methods, produce a YouTube video, or work with local chefs to produce more sustainable menus.