Engaging Students in Outdoor Learning: A Middle School Lesson Plan on Birds and their Environment

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Abstract

This project created a lesson plan for middle school students to learn about birds and raise awareness about threats to natural ecosystems. Our team interviewed middle school teachers, conducted online research, and worked with Mass Audubon to construct a series of five lessons. These lessons cover evolution, interspecies relationships, bird identification, environmental ethics and challenges bird populations face, and are accompanied by an outdoor bird watching activity. To aid in the birdwatching lesson, we created a checklist and field guide of 50 common Central Massachusetts bird species.

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Finally, all middle school teachers that participated in our online surveys and interviews that helped guide our project. The feedback we received was extremely important in shaping our project.

Authorship

James Kahn: contributed to the writing and editing of all sections of our paper. He also developed Lesson 1: Evolution and Natural Selection and the Matching Feet to Beaks activity for Lesson 2: Evolution Activity Day. James also led some meetings and interviews with teachers.

Joshua Lovering: contributed to the writing and editing of all sections of our paper. He also developed Lesson 5: Ornithologist for a Day along with the field guide and checklist for the lesson. Joshua created the All About Bills activity and the What's That Racket activity for Lesson 2: Evolution Activity Day. Joshua also led some meetings and interviews with teachers. He also took photos of birds that we were able to use throughout our project.

Bridget McLean: contributed to the writing and editing of all sections of our paper. She also developed Lesson 3: Bird Identification Techniques, the Bird ID activity for Lesson 2: Evolution Activity Day, and most of the trial lesson plan. Bridget also created the graph for our methods section and led some meetings and interviews with teachers and bird watchers.

Stephen Weaver: contributed to the writing and editing of all sections of our paper. He also developed Lesson 4: Environmental Stewardship and the Birds and Their Feathers activity for Lesson 2: Evolution Activity Day. Stephen was also responsible for creating and distributing our surveys and led some meetings and interviews with teachers.

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Executive Summary

According to *Science* writer and biologist Elizabeth Pennisi, North America has lost 3 billion birds in the last 50 years, a 30% decrease in the population (Pennisi, 2019). Because of this sudden change, our team decided to make a middle school lesson plan about birds to educate students on their local environment and bird species by introducing them to the hobby of birdwatching. The intention of this lesson plan is to raise awareness about birds while providing an exciting and interesting learning experience for middle school students. Students this age are particularly impressionable, as they begin to form opinions and perspectives on the world (Morin, 2014). Thus, teaching these students to care about birds and their environment at this age could influence their feelings and actions towards nature as adults.

An effective way to supplement indoor learning about birds is to study their habitat and behaviors outside. Dillon et al., (2005) found that learning in an outdoor environment can make lessons more memorable and impactful to students. This study also found that being able to actively find things out and do things hands on, instead of being told them in a classroom, increased the students' enthusiasm about the lessons learned. Emotional experiences can have lasting effects and in turn will keep lessons learned from being forgotten. For this reason, our team researched the benefits of outdoor learning.

The goal of this project was to create and deliver an engaging multi-day lesson plan that not only raises awareness about the declining bird population, but also piques student interest enough to be impactful. We expect that the lesson plan will engage students in a way that they retain the information more effectively than a typical classroom experience. This knowledge retention will, in turn, make students more environmentally conscious towards their surroundings and local wildlife.

Our Objectives and Methods

To meet these goals, our team implemented the following objectives:

1. Create our Central Massachusetts bird watching field guide
2. Develop an effective method to deliver class material
3. Collect class material on evolution and birds
4. Avoid negative environmental effects while bird watching

To make bird watching easy for students, our team constructed a bird watching field guide. A field guide is a comprehensive list of bird species including photos, descriptions, and frequency data. The field guide will be used by the students to identify bird species during their outdoor lesson. In order to make our field guide easy for students to understand, we included 50 commonly sighted Central Massachusetts birds. We chose which birds to include in our field guide by refining the Broad Meadow Brook sanctuary checklist with data from eBird, as well as our own sightings. Alongside a photo and description of the species, each bird in the field guide also has a frequency bar graph depicting how common the bird is throughout different times of the year. The graphs were made using frequency data from Ebird. This is helpful to students as it shows the migrational patterns of birds, as well as which birds they may see during their lesson.

Our next step in the development of our lesson plan was to research ways to deliver the material in an impactful way. We did this by conducting online research, sending a survey to Central Massachusetts middle school teachers, conducting follow-up interviews with these teachers, and implementing a condensed, trial version of our lesson plan.

Just as important as delivering the material, is deciding what that material will be. In order to make our lesson plan relevant, our team researched the Massachusetts Science Teaching Standards, utilized websites like National Geographic and Mass Audubon, looked at other bird related lesson plans online and from teachers we met with, and conducted interviews with avid bird watchers.

We also wanted to ensure that we were teaching students how to behave outdoors and to be environmentally responsible. Our interviews with teachers were helpful for deciding how we would do this, as they gave advice on conducting a class outdoors. We also researched online, using Google Scholar, into promoting environmental education to students. This provided knowledge on the ways that environmental education can connect with students and raise awareness of their surroundings. We hope this helps to accomplish our goal of raising awareness about bird species and their recent population decline.

Our Lesson Plan: Think You Know Birds?

Our findings for the development of our lesson plan revealed some key aspects that would be included in all five of the sub-units of our lesson plan. We found that dividing the class period into 15-minute segments allows for students to stay engaged with the lesson. We also

found that many teachers use a method called Backward Design in order to create their lesson plans. This consists of establishing the desired outcomes of the lesson and then creating PowerPoint slides and activities that lead to the outcomes.

Our lesson plan starts by introducing students to evolution in birds, noting the vast differences between species. To reinforce these concepts, the second sub-unit consists of a class-long evolution activity, where the classroom is split into stations and students work in groups to complete an activity at each one. The third sub-unit introduces bird watching techniques to the students, showing how birds can be identified by the traits that their species evolved. The field guide is also introduced to students in the third sub-unit, so they have time to familiarize themselves with it before bird watching. Next, they will learn how climate change affects birds, and how they can limit their environmental impact. Finally, the last sub-unit incorporates outdoor learning, allowing students to bird watch in their schoolyard with their field guide.

Our first lesson covers the topics of evolution by natural selection and interspecies relationships as they relate to bird species. The Massachusetts Teaching Standards helped us channel the information we wanted to include into material the teachers could justify teaching. Interviews with middle school teachers revealed to us that students should break up into groups in order to have them discuss conceptual questions asked throughout the lesson. The lesson covers material on evolved differences in birds' feet, beaks, plumage, migration, and interspecies relationships, with discussions dispersed in the material being taught.

From our surveys and interviews with middle school teachers in Central Massachusetts, we found that students learn best when they can apply the material they are learning about to a hands-on activity. Thus, for our second lesson, we created several bird evolution-based activities that a middle school teacher would run with their students. These activities will be simultaneously conducted in different stations throughout the room during an entire class period, and the students will rotate through each learning station.

Our third lesson is segmented into five parts: A discussion, a video on identifying birds by size and shape, a slide show on identifying ten common Massachusetts bird species, introducing our field guide, and a sketching activity. These five activities intend to teach students how to identify birds in the field using four steps suggested by the Cornell Lab of Ornithology: Identifying size and shape, color, behavior, and habitat.

To meet our objective of limiting negative effects on nature, our fourth lesson focuses on environmental education. The lesson shows aspects of climate change and its effects on birds, as well as ways that the students can get involved with helping the environment.

Our fifth and final lesson plan involves bringing students outside to practice their own bird watching. Our findings showed that teachers recommend splitting the class into two groups and using an outdoor etiquette rubric during this activity in order to give the students a more engaging educational experience. In this outdoor lesson, we also included reminders for the teachers to take safety procedures before bringing the class outdoors.

Our outdoor lesson plan also included the development of our field guide. To decide what birds would be included in our field guide, we refined the Broad Meadow Brook sanctuary checklist with data from Ebird as well as our own sightings. These findings are limited because we extrapolated the average sightings from the Broad Meadow Brook and Worcester locations on Ebird, alongside our own backyards, to the entirety of Central Massachusetts. If we had more time to research and determine the most common species, we would have taken data from a wider range of locations.

Our frequency bars were an important addition to our field guide, as they show migration information. For the frequency bars to take up minimal space while still providing the intended information, we made them short and only included four months on the x axis (see **Figure 1**).

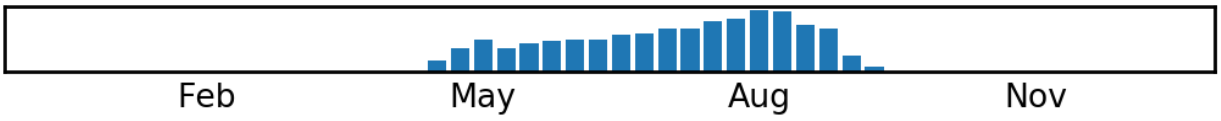

Figure 1. A frequency bar for the Ruby-throated Hummingbird. This species migrates south in the winter months and can be found back in the area during the spring and summer.

Using these bar plots students will be able to determine which species they are likely to see, as well as learn about their migrational patterns. With the frequency bars, descriptions, and photos for each species, we compiled the information into a field guide on a Google document (see Appendix F).

Our findings have culminated in our lesson plan. There are four recommendations we have for those creating lesson plans of any topic. Our team suggests interviewing teachers, using

Backwards Design, following the teaching standards for your state, and reviewing credible sources on your lesson's topic.

Through our research we have developed a method for delivering our lesson plan and engaging middle school students. Our lesson is geared towards students this age because they are at an age where they are more influenceable than adults. Because of this impressionability, we hope that students will relate to what they are taught and reflect that in their behavior towards the environment. Our lesson plan raises awareness by educating students about birds and connecting them with the species around them. By teaching students to better care about birds and environmental conservation through our lesson, they will carry these feelings and practices into adulthood.

1. Introduction

Children have been found to be spending less time outdoors than they did in the past. There was a 50% decrease in the amount of time children ages 9-12 spent outdoors from 1997 to 2003 (Hofferth, 2009). The Panel Study of Income Dynamics (PSID) collected data from roughly 3,000 children on how their week was split up amongst various activities such as school, eating, and outdoors time. Spending time outdoors has been proven to increase physical and mental health of children and adults by increasing length of sleep and lowering blood pressure (Markevych et al., 2014). In a study in Sweden, preschoolers with high-quality schoolyards, including trees, shrubbery, and hilly terrain were compared with preschoolers with lower quality yards. The students with better access to nature were shown to have longer sleep at night. (Soderstrom et al., 2013).

Dillon et al. (2005) found that learning in an outdoor environment can make lessons more memorable and impactful on students. Students who had recently visited a farm during their class time were interviewed on their experience. There was a general consensus that being able to actively find things out and do things hands-on instead of being told them in a classroom increased their enthusiasm about the lessons learned. Emotional experiences can have lasting effects and, in turn, will keep lessons learned from being forgotten.

Using outdoor learning and interactive lessons, we created a multi-day lesson plan for 7th graders. The inspiration for this lesson plan was a recent study that found that there has been a loss of 3 billion birds in North America (Pennisi, 2019). Our lesson plan raises awareness about the declining bird population while keeping students engaged. We implemented outdoor learning into our lessons because of the research that supports its usage. We expect that the lesson plan will engage students in a way that they retain the information more effectively than a typical classroom experience. This knowledge retention will, in turn, make students more environmentally conscious towards their surroundings and local wildlife.

There are various middle school lesson plans on birds, specifically those distributed by wildlife sanctuaries. However, conducting a lesson plan with a sanctuary can be difficult, as most require an employee from the sanctuary to aid the class. This option is not accessible for many schools, as sanctuaries charge a fee for sending an employee to classrooms.

This report describes the design of a lesson plan for middle school science teachers in the Central Massachusetts area. The lesson plan aims to raise awareness about the declining bird population through classroom and outdoor learning activities. To aid students in their outdoor learning, our team will also create a birdwatching checklist and field guide. These resources will help students identify birds. We hope that the outdoor learning activities outlined in this report not only engage students in a way that helps them retain the information more effectively than a typical classroom environment, but also make them healthier and more successful. We expect that this knowledge retention will, in turn, make students more environmentally conscious towards their surroundings and local wildlife.

The next section of this report sets the stage for our research proposal and gives background information relevant to the project. This includes general bird conservation efforts in North America, benefits to learning outdoors, information on Massachusetts and it's school systems, and more specifics about the Massachusetts Audubon society. The report goes on to detail the techniques we used to create our lesson plan. Finally, the results of our lesson plan are outlined in the findings section of the paper.

2. Background

2.1 North American Bird Decline

Unfortunately, North America has lost 3 billion birds in the last 50 years, a 30% decrease in the population (Pennisi, 2019). This frightening statistic was calculated using data from the most comprehensive bird survey carried out by researchers across North America. The rapid decrease has taken ornithologists by surprise, as they begin to examine the causes and find possible solutions to this problem.

The decline in bird populations is especially concerning because they are an indicator species. Indicator species can reveal trends in habitats, and, more specifically, how the habitat is changing. Rapid and unusual changes are alarming because it indicates that the environment is changing just as fast. This is often a result of human interference, such as pesticides or deforestation (Lederer, 2018). Birds are also a good indicator species because of how well they are studied. According to Scopus, over 170,000 peer-reviewed articles relating to birds have been published since 2000, with 1,680 articles being published in the first two months of 2020 alone. This wealth of information means that we have enough data to track and notice the changes in bird behaviors and populations that might indicate a bigger problem overall.

One way to raise awareness about birds and potentially curve their decline is through educational programs. In a study done on the effectiveness of an educational study called “Bird Buddies,” researchers found that students, ages 7 to 10, showed an enhanced awareness of the environment (White, 2018). Some students introduced aspects of the program at home, therefore educating family members as well. A program that integrates similar aspects of bird identification and environmental awareness, as well as mentioning bird population decline, could raise awareness both in students and in their family members. In this way, a community of people would become educated on birds, and be prepared to make steps to improve their habitat.

2.2 Current Conservation Efforts Worldwide

Conservation efforts are an important step to maintain animal populations, like birds. In the following section, we discuss current conservation efforts and how human involvement can save or harm the environment. Educating the public on the importance of conservation will likely result in more funding and participation in these efforts. By teaching the students environmental

stewardship, they will become accustomed to making positive decisions and leaving a positive impact on the environment.

2.2.1 Refuges and Sanctuaries

Due to urbanization and livestock grazing, animal species are being driven from their habitats and attempt to adapt to the changing environments around them. One means to protect vulnerable species is through local refuges and sanctuaries. These reserves synonymously serve an important role in the conservation of many flora and fauna worldwide. These are generally in the form of large nature reserves with enough habitats to support many species. Laws are in place to ensure these lands are used for environmental conservation, and not for building, farming, or hunting.

In Mexico, a study was conducted on the use of vacant city lots as small refuges. Over the period of two years, bird counts were made in vacant lots containing various amounts of vegetation (Zuñiga-Palacios et al., 2020). It was found that the bird species inhabited more of the lots as time went on. Vacant lots are successful in unplanned conservation, as they are generally established without the goal of conservation in mind. They can then be supported through planting more diverse native vegetation. These sanctuaries can be effectively created anywhere in small areas of undisturbed land as birds are found even in the loudest cities.

It is common for refuges to promote educational opportunities on site, and most refuges have teaching staff available and offer classes and tours for all age groups. These programs are geared towards educating about local wildlife, birdwatching, and environmental stewardship. Environmental education has long been important for the U.S. Fish & Wildlife Service (FWS) (U.S. Fish & Wildlife Service, 2014). The FWS offers workshops, among many other educational opportunities, at refuges across the United States.

Through education, the importance of refuges and sanctuaries can be promoted. Raising awareness to the public can lead to more support to the development of these nature reserves. This support can be both political and financial. Encouraging voters to donate or support the development of refuge infrastructure can help prevent human’s negative impact towards protected species and environments. Choosing to follow refuge guidelines and explore nature without leaving an imprint on the area, developed the idea of ecotourism.

2.2.2 Ecotourism

People travel all around the world to enjoy the beauty of nature. Vacations to beaches, rainforests, mountains, and waterfalls are all popular excursions. Visiting natural environments with the intent to support conservation efforts and observe wildlife is called ecotourism. Ecotourism can be a surprisingly efficient method of conservation, according to Katrina Brandon, a UCLA professor of environment and sustainability. Brandon (1996) lists five key conservational benefits of ecotourism:

- A source of financing for parks and conservation
- Economic justification for park protection
- Economic alternatives for local people to reduce exploitation of conservation areas and resources
- Constituency building which promotes conservation
- An impetus for private conservation efforts

Turning nature and wildlife into something that people can visit increases the demand for beautiful, conserved areas. Therefore, incorporating ecotourism into an area gives its visitors a vested interest in conserving the land.

Ecotourism can increase awareness about endangered species and ecosystems that are harmed by mankind's choice of lifestyle as well. In an article about ecotourism in Jordan, Ismaiel Abuamoud mentions that ecotourism "helps sustain the ecosystem as well as provide a platform for environmental education" (Abuamoud, 2015). One of the key necessities of an ecotourism attraction is its sustainability. If the attraction can be preserved, then future generations can continue to enjoy the beauty of nature. This can only be achieved if the community is educated about the wildlife area and agrees to protect and sustain it.

Lastly, ecotourism can be used as an educational tool to teach those about conservation. Raising awareness about how the decline in bird species can be combated will prepare individuals to make the conscious decision to support efforts such as ecotourism. With a higher support for educational ecotourism, will come more awareness and traffic at refuges and sanctuaries. This will drive up funding and public enthusiasm, as well as fuel the creation of more of these reserves.

2.2.3 Community Engagement

Community engagement is important to sustaining and creating awareness about protected areas. Without the support of the community, regulations will not be established and followed to conserve the environment. One of the ways to get the community engaged is by educating young people. This is important because they will be the ones continuing the ongoing conservation efforts. Morar (2012) mentions how "environmental education can help people gain knowledge, motivation, and an engagement needed to manage the Earth's resources and take responsibility for maintaining the quality of the environment." By teaching students about sustainability, we can ensure that they will learn the behaviors to protect and maintain Earth's natural resources. In a study about overcoming barriers to conservation through community engagement in North East Kent, England, it mentions how the project that was done organized multiple coastal walks with local experts that were designed to get people interested in the area and educate them about the importance of conservation (Roberts, 2013). The article stresses the importance of educating young people but also taking it a step further by getting the community involved with immersive events, such as walks. These types of events have been found to be popular within communities and the benefit of that is the increase in awareness of the natural protected areas (Roberts, 2013). An increase in awareness about the protected areas ties back to the education of the young people about sustainability and conservation by showing examples of successful protected wildlife areas. Another example of the connection between awareness and education is the "Find Your Park" campaign that the National Park Service started. The organization encourages the community to go and discover all the different national parks that the United States has while also offering volunteer opportunities. These opportunities enable members of the community to get involved with conserving all the natural resources in the United States, like certain endangered species.

Raising awareness about conservation to promote public support in these efforts starts by creating learning programs in the public-school system. By teaching students about their environment through engaging lessons, they will learn to leave a positive impact on their ecosystem. Through outdoor learning, students can be better connected with their environment and the material they are learning. This emotional connection will lead to a stronger understanding and memory of the lessons they learn.

2.3 Importance of Outdoor Learning

Getting the community engaged in conservation works best with educating K-12 students to think of the environment around them. This is because during this period, a person experiences a lot of growth and their time in school heavily influences the person they become when they reach adulthood. One method of getting K-12 interested in conservation is incorporating outdoor learning into lessons. Outdoor learning brings traditional in-class lessons outside where students can interact with nature as they learn. For example, when learning about ecosystems and the Earth, it is beneficial for the students to visit a local nature park and observe the ecosystem around them.

One of the benefits of outdoor learning is that it enables students to spend more time outdoors instead of spending all day in a classroom behind a desk. As mentioned earlier in our report, children in 2003 were found to spend half as much time outside as they did in 1997 (Hofferth, 2009). This is important because when students spend all day learning in the classroom, their motivation and interest to learn greatly suffers. Giving them opportunities to be outdoors at school allows for learning of earth science concepts first-hand and develops a connection with the world around them. This helps the teachers make an impactful lesson for all their students instead of just those who are able to learn in an indoor setting. In an article about the benefits of outdoor learning centers, Debra Plouts and Robert Schultz mention that “[Outdoor Learning], in turn, helps [students] experience science in context, allowing learners to incorporate science as an important part of their lives" (Plouts & Schultz, 2003). For this reason, our project targets middle school students because at this time, students are heavily influenced on what they want to do later in life. Middle school students are particularly impressionable during this time, as students this age begin to form opinions and perspectives on the world (Morin, 2014).Thus, teaching these students to care about birds and their environment at this age could influence their feelings and actions towards nature as adults.

Another benefit of outdoor learning is that it emphasizes the connection that humans have with the environment. In a research report about outdoor learning conducted by a team from the National Foundation for Educational Research in London, England, the team interviewed the staff from a London school (Dillon et al., 2005). One of the staffs’ comments on outdoor learning was “the value of using the outdoor classroom was often seen as less to do with individual curriculum topics than to do with the ability of the setting or activity to convey the

interconnectedness of the environment and man's relationship" (Dillon et al., 2005). This is ultimately the goal that we want to achieve when incorporating outdoor learning in a traditional classroom setting. Not only do the students obtain a better understanding of their surroundings, but also it shows how effective the method is to the teacher. When the research team interviewed a primary school teacher, the teacher mentioned that "I really do think that when children do leave [the] school they have a jolly good idea of [how] this works, how complex it is, how one thing depends on another, how things are linked" (Dillon et al., 2005).

A common question asked by students is "Why am I learning this?", and a simple way of answering that question is through outdoor learning. By incorporating this type of learning students can see the connection between what they are learning in the class and the real-world application of it. They will also retain more of the information taught to them and develop a better understanding if there is a way to connect the in-class lessons to the real world. As mentioned in the same research done by Justin Dillon and his team when the school visited a farm, "Reading about milking a goat and actually milking one are different though complementary experiences" (Dillon et al., 2005). Having both in-class and outside learning overall enhances what is being taught. For example, someone could read all about playing baseball and the rules, but until they step out on the field and practice, they may never hit the ball. A connection is then made between what they read in-class and how the sport is played.

The final benefit of outdoor learning is that it helps students recall from memory the lesson that is taught in-class. In the same research done by Dillon and his team, one of the students they interviewed who went on a one-day visit to a field center said that "We learnt about the wildlife and where they live and lots of habitats and animals. Where they live and what kind of areas they are in." When students can go out and physically see what they are being taught in class, the material sticks with them and they are able to connect the two. Dillon mentions later on that even the memory of a tractor ride triggers the relation that the tractor has to the understanding of food growing techniques. Overall, this technique of learning puts what is being taught in the classroom in context of the world around them. For example, a teacher can relate the physics of throwing an object and then bringing the students outside to throw a baseball around. Then the teacher can continue the lesson on physics as they throw the baseball, which not only increases their understanding of the physics, but also creates that memory so when the students see or touch a baseball, they remember the physics behind it.

While incorporating outdoor learning with normal in-class lessons may seem challenging, middle school teachers support outdoor learning to increase the impact of their lessons. Being outdoors promotes vivid memories, which can provide inspiration for writing (Eick, 2012). In the 2017 study, various teachers from Vermont who promote outdoor education were interviewed, and one first-grade teacher explained a lesson she planned in which her students visited a park and wrote a paragraph describing the qualities of a good park (Silverman & Corneau, 2017). By being able to go to the park, the students have something that they can relate to and see aspects of the park that they like and aspects that they would change. Most of the teachers interviewed believe including outdoor learning in the curriculum increases the students' understanding of ecosystems, promotes scientific inquiry, convergent and divergent thinking, and imagination (Silverman & Corneau, 2017). A second-grade teacher mentions that she can lecture indefinitely, and only some students will internalize her lessons (Silverman & Corneau, 2017). Silverman & Corneau found that when students are given an active role in their learning (e.g., exploring outside) the students are more motivated and find their lessons more valuable. This can be done by allowing the students to find something that interests them in nature followed by questions, and further information can be shared between students and teachers to promote outdoor education.

Outdoor learning can also be used to teach students about birds and the ecosystem. As mentioned earlier, birds are an indicator species. Being able to teach their importance to the ecosystem to middle school students, hopefully, will increase students' awareness of protecting the bird species. It is also important to bring the students outside to see how birds interact within the ecosystem. Incorporating outdoor learning while studying birds creates a long-lasting impression that the students will carry into their adulthood and will gain a better respect for the environment around them.

2.4 Massachusetts Geography and Birds

As described in the previous section, outdoor learning is beneficial to students and middle school teachers in Massachusetts. The geography as well as climate greatly affect what sort of learning can and should be done outdoors. Also, different species inhabit different biomes so therefore this can change which organisms students learn about.

Massachusetts is divided into 6 distinct regions based on geography. The first region is described as the Coastal Lowlands. This area is characterized by rounded hills, small lakes, swamps and short, shallow streams and a few commonly sighted birds are mallards, blue herons, and orioles (Mass Audubon, n.d. - a). Slightly further inland is the Eastern New England Upland. This area sprawls out to the west about 50 miles while slowly increasing elevation to 1,000 feet above sea level before dropping back down into the Connecticut Valley Lowland. In the Eastern New England Upland, a bird watcher can expect to see blue jays, robins, and house sparrows. The Connecticut Valley Lowlands comprise a long, narrow land area that protrudes from northern Massachusetts to southern Connecticut. This region is only 20 miles wide and a few common birds are the common yellowthroat, song sparrow, and the common grackle (Craig, 2004). The fourth region is a continuation of the Green Mountains which originate in Vermont. It is called the Western New England Upland. It is home to the Berkshire Hills as well as Mount Greylock, the highest point in Massachusetts at 3,487 feet above sea level. Some birds that inhabit the area are the osprey, the cooper's hawk, and red-bellied woodpecker. West of the Berkshire Hills lies the Berkshire Valley (iNaturalist). It consists of hills and green meadow lands and is also home to the Baltimore Oriole, the Northern Cardinal, and the Great Blue Heron (The Berkshire Eagle, 2013). The final region is called the Taconic Mountains. It lies on the western most border of Massachusetts. It is a narrow band of mountains that reach a maximum height above sea level of 2,602 (The geography of Massachusetts, 2016). In this region, a bird watcher can find robins and blue jays, but also native to this area is the Eastern Kingbirds (Mass Audubon, n.d - a).

Massachusetts' primary biome is a temperate deciduous forest. Maple, Birch, Oak, and pine are popular trees found throughout the region. The climate in temperate forests ranges from hot and humid in the summer to cold and snowy in the winter (Massachusetts, 2018.).

2.5 Mass Audubon

With our project focusing on increasing awareness about the declining bird population through educating middle school students, Mass Audubon will be a helpful resource with their extensive knowledge on the birds in Massachusetts and development of educational programs. Mass Audubon is Massachusetts' largest nature conservation nonprofit organization. They protect more than 38,000 acres of land for flora and fauna throughout the greater Massachusetts

area. The nonprofit conducts research in different environmental refuges to better understand how to preserve the areas. Besides protecting nature, Mass Audubon is instrumental in environmental education throughout the state. They handle half a million visitors a year to their wildlife sanctuaries and 20 different nature centers. Camps, school programs, and adult programs are just a few ways Mass Audubon encourages learning and environmental stewardship (Mass Audubon, n.d. - c).

One of Mass Audubon's many duties involve keeping track of bird species as well as creating resources and programs for bird watchers [known as birders]. They have bird checklists for different regions, classes for novice birders, and outing trips. An interesting feature on their website is a recent sightings page. This allows interested birders to see what birds were seen at different specific sites (Mass Audubon, n.d. - d).

Mass Audubon is dedicated to education, especially the younger generation, on ecosystems and the animals that inhabit them. A popular method of engaging a class is through a field trip. Mass Audubon has education field trips that align with the Massachusetts Teaching Standards. If the class is unable to travel to any of the wildlife sanctuaries an instructor from Mass Audubon can come to the school instead. Finally, the organization creates resources, such as lessons, for teachers to engage with their students on environmental issues and ecology (Farmer et al, 2010).

2.6 Massachusetts Public School System

The Massachusetts Elementary and Secondary Education agencies' attempt to "engage all students in collaborative, hands-on learning and engage teachers in building creative, memorable tasks designed to ignite students' interest[s]" which will "prepare all students for success after high school"(Massachusetts Department of Elementary and Secondary Education, n.d). This goal is being accomplished because the students in the Massachusetts public schools constantly score higher on exams than most other states. In fact, the Massachusetts public school system is considered to be the best in the Nation (Carapezza, 2016).

One challenge of the modern classroom education system is making sure the students stay engaged. A paper published in *The Journal of Environmental Education* studied an elementary school field trip and the long-term effects it had on the students. The goal of the field trip was to increase the students' knowledge of environmental and ecological concepts. The

study concluded that most of the students retained information from the trip for longer periods of time and became more environmentally aware (Massachusetts Department of Elementary and Secondary Education, 2016).

Teachers get guidance on what and how to teach through the Massachusetts Teaching Standards (see Appendix A). These guidelines are what the state of Massachusetts expects to be taught to students of each grade. For example, 8th graders are expected to learn about natural selection via genetic mutation. An example usually covered involves the different finches that Charles Darwin observed throughout the Galapagos islands. On islands where there were nuts the finches had strong thick beaks while on islands where the finches diet consisted of berries and insects the birds' beaks were slim and narrow (Farmer et al, 2010).

3. Methodology

Our two goals are to raise awareness about the declining bird population and to create an engaging lesson plan for middle school students that gets them interested in conservation. We expect that the lesson plan will engage students in a way that they retain the information more effectively than a typical classroom experience. The hope is that this knowledge retention will, in turn, make students more environmentally conscious towards their surroundings and local wildlife. To create our lesson plan, we collected information that fulfills the following four objectives:

1. Develop our field guide
2. Develop an effective method to deliver class material
3. Collect study material on evolution and birds
4. Avoid negative environmental effects while bird watching

To meet these objectives, we conducted semi-structured interviews with four middle school educators, an employee of the Massachusetts Audubon Society, and two experienced bird watchers. The goal of each of these interviews, as well as which objective each fulfilled, is shown in **Figure 2.**

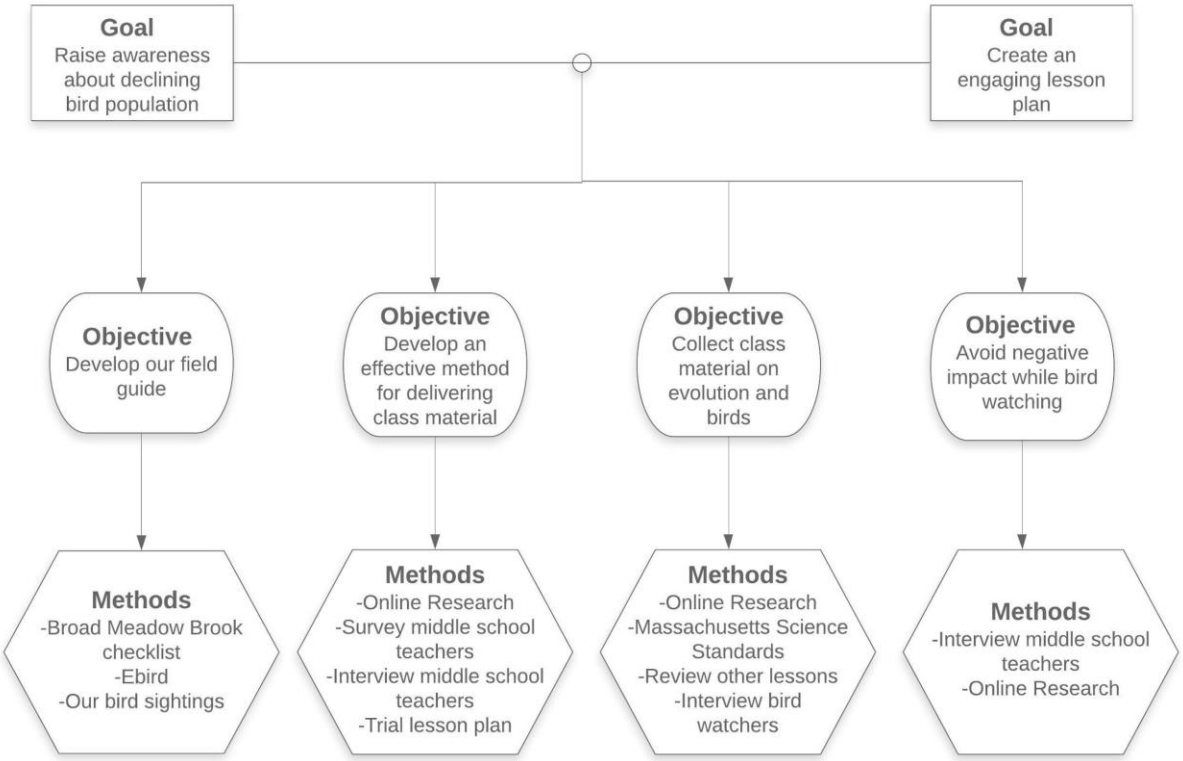

Figure 2. A flowchart showing our two goals, the four objectives we made in order to achieve these goals, and the methods we used to complete those objectives.

3.1 Develop Our Field Guide of Central Massachusetts Birds

To support the outdoor portion of our lesson plan, we developed a field guide and checklist of common bird species in Central Massachusetts. In order to pick the species included in the list we compiled bird species from one of Mass Audubon's checklists, bird sightings posted online, and our own personal bird sightings. After determining which species to focus on and creating our checklist, we gathered photos, descriptions, and frequency data for each species, to include in our field guide.

3.1.1 Identify the various bird species of Central Massachusetts

To start off determining the species that inhabit Central Massachusetts, we used Mass Audubon's checklist for Broad Meadow Brook wildlife sanctuary. The checklist contains 100 different bird species, which started our list of birds. The sanctuary protects over 400 acres of grasslands and shrublands in Central Massachusetts. Broad Meadow Brook is located in the center of this region, right next to the largest city in the area, Worcester. Due to this diverse

location, bird species from the city, the forest, the lakes, and the grasslands reside at this sanctuary. Broad Meadow Brook is also close to the schools we expect our lesson plan to be used. Because of these two factors, the bird species from this checklist will be sufficient for our lesson plan. We collected these 100 species into a spreadsheet, with a row per species.

Due to climate change, some bird species are known to have moved north where the climate has changed to what they are used to (Mass Audubon, 2017). As the checklist for Broad Meadow Brook has not been updated recently, Kristin Steinmetz, Mass Audubon's Education Coordinator at another local sanctuary, suggested that some of these species may no longer inhabit Broad Meadow Brook, and that new species may have begun to inhabit the area. In order to confirm the current accuracy of this checklist, we compared these species with regularly updated bird sightings on Ebird, where users share their sightings.

Ebird.org is a website created by the Cornell Lab of Ornithology and is highly recommended by Mass Audubon (Mass Audubon, n.d. - b). Ebird compiles large databases of bird sightings submitted by birders worldwide. This data is used by Mass Audubon's scientists to track birds within their sanctuaries. As we gathered sightings from Ebird we added 23 new species to our list which had been sighted at Broad Meadow Brook and were not on Mass Audubon's checklist. We added a column to our spreadsheet for each year from 2017 through 2020, as we are most interested in recent sightings. We also added a column for the total sightings of each species overall years of data collected on Ebird. In each row we input the number of sightings posted for each species that year. We added new rows for every species that was not already included in the list.

Our final method for determining which species inhabit Central Massachusetts is partaking in bird watching of our own. Three of our group members live in this region, from suburban to urban residences. One of us birdwatched at a local park in Worcester, another just outside of Worcester in a wooded, suburban, neighborhood, and the last of us watched from their backyard in a forested area in a smaller town east of Worcester. We actively took note of which birds and how many appeared while birdwatching. As this method was executed in early April, birds were arriving back to Massachusetts from their migration. We each birdwatched 6 different mornings at 8am for under an hour and collected our sightings on three new columns in the spreadsheet (see **Figure 3**).

	A	B	C	D	E	F	G	H	I	J
1	Species	2020	2019	2018	2017	BMB-ebird-total	Josh-	Bridget-	Stephen-	Average
2	American Redstart	26	2	1	1	1,249				343.45
3	Common Raven	14	2			1,083				210.15
4	Northern Mockingbird	11	2	1		1,037		8		197.85
5	Blue Jay	4	2	3	2	1,597	4	5	16	195.85
6	Hooded Merganser	13	1			443				160.15
7	Barn Swallow	5	1			1,482				132.1
8	Prairie Warbler	=(10*B8)+(8*C8)+(4*D8)+(1*E8)+(0.05*F8)+G8+(2*H8)+(2*I8)								128.3
9	Rock Pigeon	4	1		2	1,566				128.3
10	Turkey Vulture	8	2	1		506				125.3

Figure 3. A screenshot of our spreadsheet described in this section which we used to compile the data from Mass Audubon, Ebird, and our personal sightings. Including the formula for row eight.

After going through the above methods, we had a thorough understanding of the bird species that inhabit this region. Finally, we calculated averages for each species across the entire row. In order to combat the displacement of species due to climate change, we arbitrarily weighted the sightings in 2020, 2019, 2018, and 2017: by a factor of ten, eight, four, and one, respectively. To prevent skew as a result of the totals Ebird column being generally thousands more than the individual years, we weighted that column by 0.05. Our personal sightings were weighted by a factor of two, with an exception for one team member, who we weighted as a factor of one, since he lives further outside of Central Mass. We chose these low weights because the sightings are limited to our backyards yet are still relevant data from 2020. We used these weightings to calculate an average for each species, in another column on the figure. We then sorted the list from highest to lowest based on our average column.

3.1.2 Gathering content for the field guide

Once we had an extensive list of Central Massachusetts birds, ordered from most to least common, we created our own checklist. As our checklist was used in our 7th grade lesson, we made it concise with a variety of commonly seen bird species. The checklist contains 50 birds so that it is more comprehensible and not as overwhelming as compared to Mass Audubon's checklists which contain over 100 different birds. Only bird species which have been sighted often in recent years, based on our averages, were included in the checklist, alongside a few rare birds for students who like a challenge. A total of 73 bird species were cut from our list. The

checklist is organized by type of bird. For example, all the Warblers are listed in one section of the guide. Alongside the checklist, which will give students an idea of which species they can expect to see, we created a field guide to help students identify the birds they do see.

The field guide includes the species from our checklist alongside a few others. We added additional birds to the field guide to help the students identify a wider range of bird species. It is organized the same way the checklist is. For each bird a photograph is included. There are also descriptions of this birds' behaviors, common food and nesting sources, where this bird may be found, and other facts about the species. The descriptions were quoted from the Cornell Lab of Ornithology and from Mass Audubon. Lastly, there is a frequency bar for each bird.

Each bar graph represents the span of a year and displays the frequency a bird can be seen at each given time of the year. This data is available for download from Ebird in the form of Tab Separated Values files. Each birds' file contains a frequency for each week of the year based on an average from past years at a given location. This data was read by a Python script that we wrote, using file reading and data plotting libraries. The data for each bird was plotted on a bar graph.

Alongside the checklist and field guide, we created our lesson plan based on feedback from interviews with Mass Audubon members and middle school teachers.

3.2 Developing an Effective Method to Deliver Class Material

To develop the best method for delivering course material about birds and ecosystems, we conducted online research to see examples of similar lesson plans that helped in developing ours'. With our lesson plan focusing on teaching students in middle school, we researched lesson plan templates using keywords such as "lesson plan templates" and "middle school lesson plan templates". Using Google, we found that there are some databases in which middle school teachers upload templates that they use for their middle school classes. Two databases that we found were sharemylesson.com and pbslearningmedia.org. On the website, Share My Lesson, the lesson plans are rated on a 5-star scale by other teachers that have used the templates. On Public Broadcasting Service's website, pbslearningmedia.org, they offer many different lesson plans for all grade levels that are specifically for Massachusetts teachers. We were able to analyze these lesson plan templates, see the similarities and differences between them, and develop our own lesson plan template that we could use for the material we wanted to deliver.

Another method that we used to develop course material was to survey middle school teachers in Central Massachusetts (See Appendix B). This survey looked to obtain information on what we can do to have our lesson plan have the most impact on the students, as well as any initial flaws that might come with our program. We also asked the teachers what grades they teach and how long the class period is. This enabled our team to determine the methods that worked best when teaching middle school students and what possible constraints there were as we began to develop our lesson plan. One example of a constraint that we faced was time because we needed to make sure that enough time was allocated for the lesson plan in a teacher's schedule. The last question on the survey asks if the teachers would be interested in follow-up questions. This allowed us to give the teachers our lesson plan to try out in their classes. We were able to send our survey to five Central Massachusetts middle school teachers that were recommended to us by Kristin Steinmetz of the Mass Audubon. We conducted the surveys by sending them an email with the survey attached and gave them the option to send it to other science teachers after completing the survey. From the four teachers that completed the survey, two accepted to do a follow-up interview with us in which we had the opportunity to conduct a more in-depth interview (See Appendix C). This was done using semi-structured interviews where we followed a list of questions we created beforehand. Some of the questions that we asked were about how the teachers create lesson plans, the kind of activities they run with their students, and how often they take their students outdoors for a lesson and if it is beneficial.

Our last method was to give our trial lesson plan to a middle school teacher to conduct it in their middle school classroom. Due to COVID-19 causing school closures, we were not able to have our full lesson plan tested in a classroom setting with the students going outside. Instead, our team created a condensed version of our lesson plan from lesson 3 and lesson 5 in which the teacher conducted an online lesson. This lesson taught the students how to identify birds and then had them birdwatch at their homes for three days. The students were tasked with creating a list and count of birds that they saw in their backyards. To test our lesson plan, the teacher was given a pre-assessment and post-assessment to give to their students which had questions about the birds they can identify before and after going through the lesson and birdwatching. While we were not able to test to see if our lesson plan would raise environmental awareness, we were able to test if the lesson plan was engaging if the student's ability to identify the birds improves after being taught how to identify bird and bird watching. After the trial lesson was completed, we

looked to answer some questions like how many students participated in the survey, what was their opinion on the lesson and bird watching, and what are some improvements we could make to the lesson to make it better for the teacher and students. From here we were able to create a final product of our lesson plan that we could give to the Mass Audubon as a resource to them and middle school teachers.

3.3 What are introductory facts and behaviors on birds?

Along with finding the best ways to deliver the lesson plan, we needed to decide what were some necessary introductory information about birds and their environment that middle school students should know. We found the most comprehensive introductory bird facts for our lesson plan by conducting online research on specific websites such as Mass Audubon and National Geographic. We were interested in basic information on the 50 most common bird species in Massachusetts, with the obtained information including physical attributes, mating habits, migration, diet, and commonality. The information came from The Cornell Lab or Ornithology and Mass Audubon. Gathering this information aided us in creating our lesson plan as well as the bird field guide and checklist. The resources we used to obtain this information included websites that specialize in nature, evolution, and birds. Another valuable resource for obtaining this information was Mass Audubon. They have a large amount of information on the bird species that inhabit Massachusetts. However, some of their data about the populations of certain bird species may be out of date due to changes in the ecosystem. We cross referenced Mass Audubon's information with data from other sources to ensure our lesson plan was up to date.

As a base for our lesson plans, we used the Massachusetts Life Science Standards for seventh and eighth grade when creating our lesson plan (see Appendix A). This also helped us decide which topics we needed to address when creating a unit on birds and ecosystems. Middle school teachers are also more inclined to use our lesson plan if it relates to the science standards and, in terms of possibly taking the students outside the classroom, the teachers will also be able to convince the administration to do so for educational purposes.

We guaranteed the success of our lesson plan by getting inspiration from bird learning programs that had already proven successful. For example, one of the bird programs that we looked at was from Mass Audubon. The lesson introduced students about birding in their

schoolyard and at home. We adopted some of these ideas for our project. We also reviewed a lesson plan from Lara Didden who is a middle school teacher from Viewpoint School in California. We interviewed her to obtain a broader view of developing a lesson plan for middle school students. Her lesson clearly indicated the importance of keeping the students engaged and learning in the classroom before they go outside to bird watch. Her presentations had pictures as well as audio of each bird they could see. These lessons offer valuable insight into what type of information we should include in our own lessons as well as new information about birds that we had not found before. Another way we obtained information about the bird species was through the online research into current bird lesson plans that focus on the general Massachusetts area. One of Mass Audubon's goals is educating the public about the ecosystem. Because of this, the organization already has some introductory material for younger students. Their current lesson plans are for preschool and K-5th grade.

In order to get different perspectives on the bird information we interviewed avid birders (See Appendix D). One of these birders was Professor Bakermans. She is an ornithologist who teaches biology at Worcester Polytechnic Institute. She helped with our formation of a field guide and bird checklist as well as providing suggested materials and feedback on our lesson plan. Another perspective we brought to our project was that of an avid bird watcher. Professor Quimby, from Worcester Polytechnic Institute' Physics department, has many years of experience bird watching in Institute Park in Worcester. We used his expertise in order to decide what introductory material would be best to engage new people with this hobby.

3.4 How to limit negative effects while bird watching

Along with the information on birds included in our lesson plan, we also offered advice on how to limit negative effects while bird watching. This project aims to encourage students to spend more time outdoors. However, it is important to teach students about their effect on the ecosystem to avoid having a negative impact. Specifically, we made a point of how habitat disruption can be detrimental to birds. By teaching students to limit their adverse effects on the environment, they will be more likely to enjoy the benefits of outdoor learning without causing harm to their surroundings.

We started to find ways to incorporate the environment into our lesson plan by conducting interviews. Our interviews with Central Massachusetts teachers were helpful for this

task, as some were experienced with using outdoor learning in their classrooms (see Appendix C). Questions like “How often do you take your students outside of the classroom to run an activity?” and “What are some concerns and/or issues that you think might come up?” prompted teachers to give us advice. The advice they gave included outdoor rubrics, splitting the class size outdoors, bringing bags to collect trash, and other ways to keep the environment safe in our lesson plan. We were then able to assess which suggestions would fit best in our project.

We also conducted online research to learn more about educating students about the environment. Using Google Scholar and the keywords “promote environmental education students,” we reviewed articles related to the effectiveness of environmental education. We selected a handful of articles, based on credibility, that provided insight on how to deliver the most impactful lesson plan. We want to reach a wide audience of students with our lesson plan, in order to raise awareness in the most amount of people. Therefore, our lesson plan needs to be engaging, and these articles shed light on how other programs were able to interest other students.

4. Think You Know Birds? Our Lesson Plan and Field Guide

4.1 Developing an Effective Method to Deliver Class Material

We researched examples of middle school lesson plan templates online, surveyed and interviewed middle school teachers, and conducted a condensed version of our lesson plan with middle school students. When developing the most effective method to deliver class material to middle school students, we found from surveying middle school teachers that incorporating both in-class lectures with hands-on activities was important in engaging students (see Appendix B). This method was found to be effective because there are students that learn visually and students that learn by hands-on activities. These students have different needs in the classroom, and lesson plans that aim to engage both types of students need to meet these needs. We also found from interviewing two middle school teachers that including a lesson outdoors is beneficial to help students further their understanding of the material (see Appendix C). This was found by giving surveys to five middle school teachers that teach in Central Massachusetts, and conducting interviews with four middle school teachers, two from Central Massachusetts, one from California, and one from Canada.

When we researched examples of middle school lesson plan templates online, we found that it usually contained a lecture the teacher could use as well as an activity. They also included the learning objectives, essential questions, vocabulary and the learning activities that the teacher would run with their students. With that information, we borrowed a template adapted from Understanding by Design 2nd Edition by Grant Wiggins and Jay McTighe (Wiggins, 2005). These lesson plan templates can be used for any grade K-12 and each lesson plan is based on the idea of Backward Design. This approach starts with the teacher deciding on the ultimate desired outcome the teacher wants. Next, the teacher creates lesson plans with lectures and activities that lead to those desired outcomes. The book offers a lesson plan template that we adapted our own lesson plan. This template divides the lesson plan into three sections; Stage 1: Desired Results, Stage 2: Evidence and Assessment, and Stage 3: Learning Plan. We adjusted our lesson plan by including the Massachusetts Science Standards (see Appendix A), essential questions, objectives, and vocabulary to Stage 1. We also included the materials that the teacher might need for each lesson and potential homework that they could give to their students. To use the Backward Design process in our lesson plan, we want the students to have a better understanding of the

importance of the birds to an ecosystem and to learn about ornithology. We then worked backwards and developed lessons and activities that reach those outcomes.

By emailing a survey about how to create lesson plans to five middle school teachers in Central Massachusetts, we found that students during middle school are generally visual learners (see Appendix B). As one teacher mentioned in our survey, "The more pictures, diagrams, videos, and hands-on activities you can provide will not only engage them, but will make them more likely to remember information." From here, we made sure to develop different slide shows within our lesson plan that not only presented the information we wanted them to know about birds, but also included images and videos that go along with the information. From our interviews with two of the five Central Massachusetts middle school teachers, we found that both teachers thought that taking students outside was beneficial for their understanding of the lesson and would take their students outside frequently (see Appendix C). One teacher would take their students out once every two weeks for outdoor lessons while the other teacher would teach outside twice a week. In our lesson plan, we included a day where students go outside and study birds in their schoolyard or a nearby park. The teachers we interviewed confirmed that they like this idea and it would be very helpful to middle school students in their understanding of what an ornithologist is and how to study birds. From our surveys, we found that most teachers have about a 50-minute class period to conduct their lessons. However, our interviews revealed that the time to introduce new material is closer to a 40-minute class period. This is because teachers like to start the class with an opener activity to initially engage the students in the lesson, and end the lesson with a closer activity which allows the students to think back to the lesson and the information they learned. Through both the surveys and the interviews we were able to combine this information with the Backward Design to incorporate videos, activities and our outdoor lesson into a lesson plan that we could give to middle school teachers to use in their class.

After developing a lesson plan prototype, we created another survey to obtain feedback for our lesson plans and emailed them to two middle school teachers that we previously sent surveys to as well as 15 students studying to become teachers at Worcester Polytechnic Institute (see Appendix E). From the surveys, we found that while we were knowledgeable about our subject matter on birds, there was too much information for a one-day lesson. According to feedback, the lessons we had created could span potentially 2-3 days. For this reason, instead of calling each lesson "Day 1 Lesson", we should call them "Lesson 1". This way, the teacher does

not feel overwhelmed by all the material that we put into one lesson for one day. It also gives teachers the freedom to customize the length of our lesson plans based on their schedule and students. We also received feedback for each day individually and found that our slideshows should include slides where students form small groups for discussion. Within these discussions, the students can talk about a prompt given to them that relates to the lesson. These discussions also help the students think critically about the material being taught and discuss collaboratively with other students. Within our lesson plan, we added slides with discussion points in which the teacher can pause lecturing and allow the students to go into small group discussion.

Lastly, we created a trial version of our lesson plan and sent it to a middle school teacher to try with their middle school students. We found that students were able to find, on average, four more birds after going through our lesson and each saw an average of ten different bird species. This was accessed by giving the students a pre and post assessment that included questions on their knowledge of birds before and after going through the lesson. The students were also given a video on bird characteristics and how to identify birds. We had a casual meeting with the teacher after the trial lesson and asked her questions on what worked and what could use improvement. From the interactions with their students, the instructions of the activity were easily understood and the learning material that was given was also easy to follow. One addition we could have made to the lesson to make it better, would have been to add a sketching portion in which the students would draw either a bird they saw or the habitat that the bird lives in. This would require the students to use the information they learned from the lesson, as well as recall the activity they did to draw the bird or habitat accurately. Lastly, we found that the students enjoyed our lesson plan. This is important because, not only do we want students to learn from our lesson, but we also want to make sure that our lesson plan is also enjoyable to those that go through it. One limitation to our trial method is it was voluntary. Due to COVID-19, the teacher asked for student volunteers to participate in our online lesson plan, rather than making it a requirement for the class. Because of this, only those who had an interest in the project participated in it, meaning they are more likely to be engaged with the material. Had this been conducted as a traditional classroom lesson, students who were not previously interested in birds may not find the material as engaging.

4.2 Developing a Field Guide for our Fifth Lesson

4.2.1 Identify the Various Species of Central Massachusetts

After gathering bird sightings from Ebird along with our own sightings, we had a list of 123 bird species. By applying our equation, mentioned in the Methodology section, and organizing the data from most to least frequent, it was revealed to us which species from Mass Audubon's Broad Meadow Brook checklist were still commonly found in the area. As we only gathered bird sightings from Broad Meadow Brook and our personal residences, our findings are limited. We extrapolated this data to the entirety of Central Massachusetts for our project. We find this suitable because our lesson plan will be distributed by an Educational Coordinator at Mass Audubon from the Broad Meadow Brook area. Thus, all schools that we expect to use our lesson plan will be near Broad Meadow Brook.

4.2.2 Gathering Content for the Field Guide

We started our field guide by creating our checklist (see Appendix F) and gathering descriptions and photos of the 50 bird species from the Cornell Lab of Ornithology and Mass Adubon. We then began to create the frequency bars, using data downloaded from Ebird. For the frequency bars to take up minimal space while still providing the intended information, we made the plots very short and only included four months on the X-axis (see **Figures 4 and 5**).

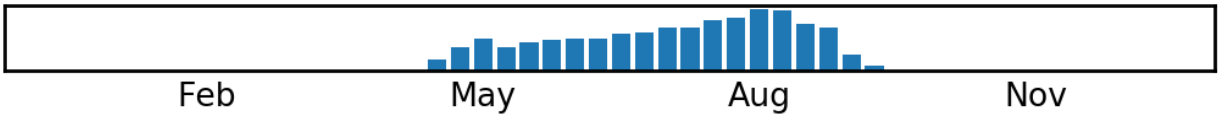

Figure 4. A bar plot for the Ruby-throated Hummingbird. This species migrates south in the winter months and can be found back in the area during the spring and summer.

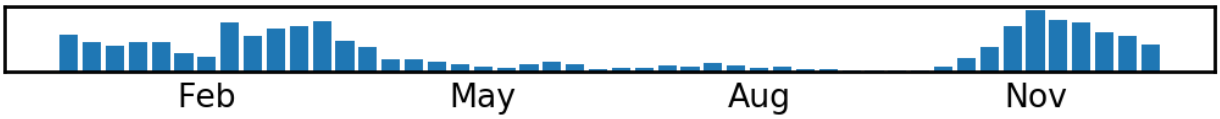

Figure 5. A bar plot for the Hooded Merganser. This duck winters in Central Massachusetts and areas with similar climates and travels back north during their breeding season.

The frequency bars visually represent at which time of year a species can be found in Central Massachusetts. Through these bar plots one can learn about the patterns of various species and see if and when they migrate. Species like the Ruby-throated Hummingbird are found to migrate south during the cooler seasons and come back north to areas like Central Massachusetts during their breeding season. This differs from species such as the Hooded Merganser which winters in Central Massachusetts and areas with similar climates and travels back north during their breeding season. Many of the species we researched reside in the Central Massachusetts area year-round and have no migration patterns. These species switch diets in the winter months when insects are less prevalent but there are still berries and seeds available.

Using the frequency bars, students can determine which species they may see while they are out birdwatching. This is useful as our lesson may be delivered at any time during the school year. Throughout the year, some of the species in our field guide will come and go from the area. The frequency bars will not only inform the students of which birds they may see but will also teach them about the migration patterns of birds they regularly see throughout the year. With the frequency bars, descriptions, and photos for each species, we compiled the information into a field guide (see Appendix G). An example of an entry from our field guide is shown in **Figure 6**.

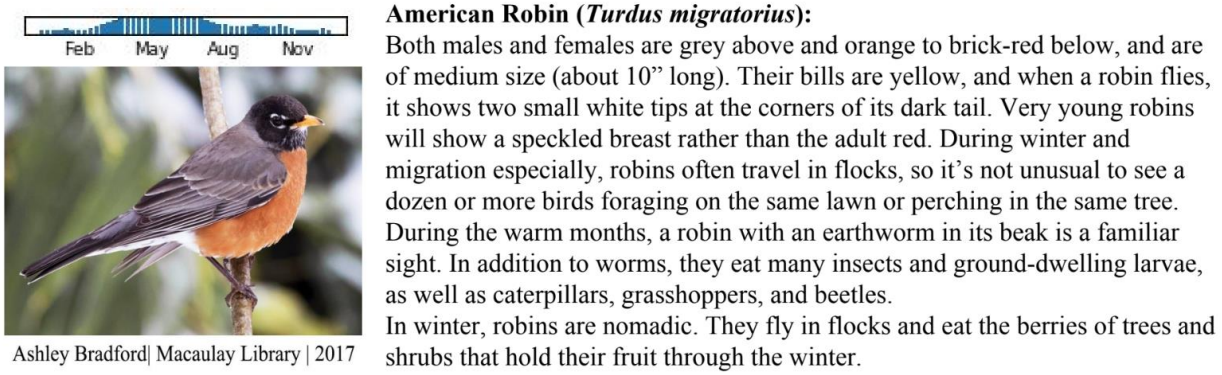

Figure 6. A screenshot of the American Robin from our field guide, including a photo, species description, and frequency bar.

4.3 Creating Our Lesson Plan: Think You Know Birds?

4.3.1 Lesson 1: Evolution and Natural Selection

The main goal for the day one lesson (see Appendix H) is to introduce students to the topics of evolution through natural selection as well as interspecies relationships as they relate to bird species. National Geographic and Mass Audubon also aided in the formation of the interspecies relationships section of the lesson. The definitions for the relationships were paraphrased from a National Geographic website. Also, understanding these definitions allowed further research into interspecies relationships that relate to birds.

Research into current online lessons from Mass Audubon and middle school teachers taught us the necessity of keeping students engaged through visual means. Large pictures, videos, colorful fonts, and fewer sentences on presentations are very important. Mixing up the lesson through activities and knowledge checks is another great way to keep the students active and learning. Because of this research, our first lesson has multiple videos that detail birds catching prey, evolution, and interspecies relationships. Knowledge checks, colorful slides, and pictures are prevalent throughout the lesson.

The Day 1 lesson starts out by showing a video of an eagle catching a salmon and chickens eating corn. This is to get students thinking right off the bat about the huge variations in bird species. Next, students are introduced to the differences in feet and beaks between different birds. Students are supposed to guess the use of each type of bird foot and beak by their distinctive look. This then segways into an evolution video about Darwin's Finches. The next series of slides introduces the basics of migration and plumage. Students are then given a concept check about evolution, followed by an introduction to the five interspecies relationships. The slides are colorful and include videos and pictures. Occasionally, the lesson has students breaking up into groups to discuss the big questions.

4.3.2 Lesson 2: Evolution Activities Day

From our surveys and interviews with the Central Massachusetts middle school teachers, we found that one method for keeping the students engaged with the lesson is to incorporate hands-on activities. Using stations as part of the lesson helps the students develop a deeper understanding of the material they are learning about in class.

Our second lesson allows students to have hands-on experience with what they learned from the Evolution and Interspecies Relationship Day. The Activities Day (see Appendix I), includes five different hands-on activities that a teacher could use. We envisioned that a teacher could spend one class period running these activities as stations and having the students rotate in small groups from station to station. Our activities have students learning about different beak types, associating types of feet to different beaks and learning how a bird uses them, learning to identify birds, learning about different types of feathers, and a bird call activity. From these activities, students will develop a better understanding of evolution and characteristics of birds.

4.3.3 Lesson 3: Bird Identification Techniques

The purpose of our third lesson plan (see Appendix J) is to teach students about bird watching techniques. To create this lesson plan, we used four basic steps to bird identification: size and shape, color, behavior, and habitat. These steps are used and recommended by the Cornell Lab of Ornithology (The Cornell Lab, n.d.). Thus, learning about and discussing these four characteristics became the focus of the lesson plan.

As we learned through our interviews with middle school teachers (Appendix C), it is important to make ties between our lesson plans. For that reason, this lesson plan begins with a discussion question: "Based on what you learned in the previous lesson, how can you tell different birds apart?" The lesson plan also suggests that teachers have students write their answers on the board to save for reference throughout the lesson plan. This connects what the students have previously learned about evolution with the bird identification techniques that they will learn in this lesson.

As mentioned before, we learned through our interviews and surveys how important it is to break the lesson up to keep the students' attention. In order to break up our third lesson plan, we included a video on identifying birds by shape and size. This video was created by the Cornell Lab of Ornithology as part of a four-part series on bird identification. Through our own experiences as new bird watchers, our team has found that size and shape can be the most difficult technique to use. For this reason, we found it most important to aid the students in their size and shape identification skills. The end of this video briefly mentions the four steps to bird identification, which introduces it to the students. This prompts the teacher to start a discussion

afterwards, comparing these identification techniques with the student suggestions from the beginning of class.

To allow students to familiarize themselves with identifying these four characteristics, we created a slideshow of ten birds commonly found in Central Massachusetts. Each slide features a picture of the bird to show its color, as well as a description of its size and shape, behavior, and habitat. This gives students a reference for what these four characteristics mean on different birds. This slideshow also familiarizes students on the birds they will see in their area. We hope that showing the students what these birds look like will make it easier for them to identify common birds while bird watching in a later lesson.

Finally, it was recommended that time was set aside for teachers to introduce students to our field guide (Appendix F). We chose to include this in our third lesson because of how important the field guide is to bird identification. After consulting with teachers through interviews, we decided to recommend teachers print enough field guides for each student or to share between two or three students. Instructions were included in the beginning of the field guide describing its importance, how it is organized, how to read the frequency bars, the four steps to bird identification, and other tips on identifying a bird. We hope that allowing the students to examine the field guide will help to familiarize themselves with it before participating in their own bird watching on day 5.

4.3.4 Lesson 4: Environmental Stewardship

Through our online research we found that teaching students about harmful environmental effects can make them feel more connected to nature (Liefländer, 2012). This connectedness to the environment makes students less likely to cause harm to their surroundings. Since this outcome is one of the objectives for our project, we included a lesson on the environment in our lesson plan (see Appendix K). We specifically include harmful effects to birds in this lesson to make students feel connected not just to the environment, but to birds as well. We included topics such as climate change, the Deepwater Horizon oil spill, and ways to help the environment, like conservation and nature reservations. This makes the lesson both effective and relevant to the other course material.

The lesson starts by showing students the effects that humans can have on birds. This is shown through a description of the Deepwater Horizon oil spill. Then, the four major effects of

climate change on birds are introduced to the students: habitat loss, changes in migration, changes in food availability, and changes in nesting. We hope that showing students the effects that human activity and climate change can have on birds will strengthen their connection with nature.

The lesson then moves on to show the students how they can help the environment. This is done by going over examples on how to reduce, reuse, and recycle, also known as the three R's. We also provide other ways to reduce negative environmental impact by reducing carbon emissions. Finally, we provide examples of preservations and sanctuaries dedicated to protecting wildlife. We hope that teaching the students how they can make a positive impact will encourage them to think more carefully about their interactions with their surroundings.

Finally, part of this lesson includes an introduction to ornithology. This would ideally be introduced the day before their birdwatching lesson. Students learn about what an ornithologist is and what they do, as they will be acting as ornithologists the next day. Admission outside is only allowed after the students list five birds they may see the next day. This prepares students for their next lesson and gets them thinking about the next day's activity.

4.3.5 Lesson 5: Ornithologist for a Day

The last day of our lesson plan (see Appendix L) culminates with an outdoor experience for the students. With the previous day's information, the field guide, and bird familiarity, the students should be ready to put their bird watching skills to the test.

We found that an effective way to minimize impact on the environment would be to split the class into two groups. This method was suggested by several Central Massachusetts middle school teachers throughout our research. A smaller group would aid in reducing negative environmental effects, as the teacher or supervisor can more closely monitor the students to ensure they are not causing harm. Splitting the class into two groups would also help with the success of the class' birdwatching. This is because a smaller group will be less noisy, and the teacher will have an easier job controlling a smaller group. During the day, birds are less active and are less likely to be feeding out in the open than in the morning or the evening. Because of that, it is even more important to be quiet while bird watching so as not to scare the birds away.

To aid the teachers in only taking out half the class at a time, we created an alternate lesson layout that can be followed. If the teacher can procure an assistant teacher, a parent

volunteer, or a Mass Audubon teacher representative, we recommend that they follow our alternative layout. By moving the second lesson (stations activity) alongside the outdoor lesson, half of the class can participate in the activity while the other half goes outside. The next day the group that did the activity will go outdoors and the other group will do the activity.

In our interviews, we spoke with a Central Massachusetts teacher who frequently takes students outside for lessons and activities. This teacher found that an effective way of controlling student behavior is to give them a rubric. This rubric shows the students how their actions outside will reflect their grade for their outdoor lesson. The teacher will go over the outdoor learning rubric with the class before their lesson so the students know what behaviors will be expected. This also helps to remind the students that while outside they are still in class time, and not a recess. According to the teacher we spoke to, reviewing the rubric improves student behavior, meaning they will be less likely to cause harm to their surroundings. We included our own version of an outdoor rubric in our lesson (see Appendix M) with the intention of controlling student behavior and limiting a negative environmental impact.

Professor Bakermans at WPI told us about their introduction to the hobby of birdwatching and the field of ornithology. A very important lesson she revealed to us is the importance of hands on experience. By giving the students an opportunity to become involved with birdwatching outside of the classroom, they will likely become more engaged. Being able to hear and see their local bird species, after learning more about their features and evolution, will relate the lesson with their everyday life.

Our last finding while interviewing about the fifth lesson, was to have an emphasis on safety in our lesson plan. We were told by a teacher of over 30 years to include a reminder to follow safety precautions while preparing for and running the outdoor lesson. The teacher we interviewed mentioned that this level of consideration for all aspects of our lesson will gain teacher's appreciation of our plan and make them more likely to use it. In the preparation portion of the fifth lesson plan timeline, we included a note to ensure the teacher is prepared to bring the students outdoors. In this lesson we remind the teacher to check in with the nurse regarding their students, to make sure any Epi-Pens and any other medications are close at hand, to have a phone or radio in case of emergencies, to give the administration notice of the date and time of the outdoor lesson, and to execute any other school procedures before bringing the class outdoors. Teachers will already know to do most or all these things before bringing their class outside. By

adding this into our plan we show that we have considered more than just the material and layout of the lesson.

5. Conclusions and Recommendations

Our lesson plan serves to engage students through interactive lessons and outdoor learning. Through our five lessons, students are introduced to a variety of the Massachusetts middle school science standards through bird ecology and evolution. The combination of visual, discussion and hands-on portions of our lessons aid in all types of learning styles. In this section we briefly highlight our main findings from creating our lesson plan, and then delve into recommendations for those conducting similar research and creating lesson plans in the future before finally explaining the impacts of our research.

5.1 Lesson Plan

In regard to creating a lesson plan about birds, we concluded that the best method to deliver material to middle school students is to include a mixture of lecture, hands-on activity, and outdoor learning. In order to keep students engaged during a lesson, we divided the class period up into 15-minute segments that include lectures, videos, and activities that surround one topic. Not only are the students' attentions regularly recaptured, but the variety in activities and lectures gear towards students of all learning styles.

The first lesson starts out by introducing students to the various feet and beaks that different bird species adapted over generations. This then segways into an evolution video about Darwin's Finches. The lesson also goes into migration and plumage, and occasionally breaks the students into groups to discuss thought questions.

For our second lesson, we created different stations that a middle school teacher could run with their students. From our surveys and interviews with middle school teachers in Central Massachusetts, we found that students learn best when they can apply the material they are learning about to a hands-on activity. Our activities include learning about different beak and feet types, learning to identify birds, learning about different types of feathers, and investigating the various types of bird calls. With these different activities, students will improve their understanding of evolution's effect on bird features and how to identify the birds they see.

We concluded on segmenting our third lesson into four parts: A discussion, a video on identifying birds by size and shape, a slide show on identifying ten common Massachusetts birds, and introducing our field guide. By learning these topics students will be prepared to identify and differentiate bird species on their own.

To meet our objective of limiting negative effects on nature, our fourth lesson focuses on environmental education. The lesson shows aspects of climate change and its effects on birds, as well as ways that the students can get involved with helping the environment. We concluded on teaching students about environmental education as it can form a feeling of connectedness with nature and deter them from causing harm to their surroundings.

In order to give the students an engaging educational experience while preventing negative impact on the environment, we split the class into two groups. By only bringing half of the class outside the teacher will be able to better monitor the students to prevent them from causing harm to the environment. A smaller class will also be easier to keep quiet, thus less likely to scare the birds away.

After determining 50 common bird species in Central Massachusetts, we compiled them into a checklist and a field guide. A limitation to our methods of determining which species to include is that the sightings we examined were taken from the Broad Meadow Brook Sanctuary and Worcester locations on Ebird. We extrapolated these findings for the entire region. If we had more time to research and determine the most common species, we would have taken data from a wider range of locations. There is user data from most parks and cities in Central Mass on Ebird, which we could have gathered. Using a more representative dataset, we could have calculated a higher accuracy average for the number of sightings of each species in the area.

Below are our recommendations from the lessons that we developed based on the surveys and interviews that we conducted with the Central Massachusetts middle school teachers and the student teachers from Worcester Polytechnic Institute.

5.2 Recommendations

There are four recommendations we have for those creating lesson plans of any topic. The first is to interview teachers. Teachers who educate the same grade level you are developing a lesson plan for can recommend various lesson structures to engage students of all learning styles and know how to keep students engaged through classes of all lengths and sizes. As you are developing a lesson plan for teachers, learning from them and utilizing their feedback will guide your lesson plan into a suitable product they can use or adapt. We also recommend using backward design as adapted by our team from *Understanding by Design* by Grant Wiggins and Jay McTighe. This allows teachers to establish the outcomes and goals of their lessons and work

backwards to make a lesson plan that meets those desired outcomes. Our next recommendation is to follow the state teaching standards for the grade level and subject of your lesson plan. Teachers have many topics to cover throughout the year and can only utilize lessons which educate students on material required by the state. Our final recommendation is to review credible resources in the field you are creating a lesson plan on. When picking material to include, these resources will provide you with a wide range of entry to experienced level topics and information. Highly recognized organizations that have developed many resources will likely have educational lessons and activities created you can utilize or adapt in your lesson.

5.3 Impacts of our research

Through our research we have concluded on an effective method for delivering our lesson plan and engaging middle school students. Our diverse and interactive lessons will engage the students while learning about the environment they live in. The lesson plan raises awareness by educating students about birds and connecting them with the species around them. By teaching students to better care about birds and environmental conservation, they will most likely carry these feelings and practices into adulthood.

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Appendix A: Massachusetts Life Science Standards

The following are from the Massachusetts 2016 Science and Technology/Engineering Curriculum Framework. The excerpts below are taken from the life science sections for 7th and 8th grade.

Grade 7

7.MS-LS1-4. Construct an explanation based on evidence for how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants. Clarification Statements:
• Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalizations and colorful plumage to attract mates for breeding.

7.MS-LS2-2. Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems. Clarification Statement:
• Emphasis is on describing consistent patterns of interactions in different ecosystems in terms of relationships among and between organisms.

7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. Clarification Statement:
• Focus should be on ecosystem characteristics varying over time, including disruptions such as hurricanes, floods, wildfires, oil spills, and construction.

7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.* Clarification Statements:
• Examples of design solutions could include water, land, and species protection and the prevention of soil erosion.
• Examples of design solution constraints could include scientific, economic, and social considerations.

Grade 8

8.MS-LS4-4. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals' likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations. Clarification Statements:
• The model should include simple probability statements and proportional reasoning.

• Examples of evidence can include **Darwin's finches**, necks of giraffes, and peppered moths.
State Assessment Boundary:
• Specific conditions that lead to natural selection are not expected in state assessment.

Appendix B: Survey Massachusetts Middle School Teachers

Preamble: We are a team of third year undergrad students from Worcester Polytechnic Institute in Worcester, Massachusetts. From March until May, we are working with the Massachusetts Audubon Society to develop an educational program for students to learn about their local environment through bird watching. This program will align with the Massachusetts Middle School science standards in order to make it relevant to current courses. The program will include a field guide to learn more about different bird species. We will also create a checklist of Central Massachusetts birds that can be used alongside the field guide when bird watching to identify different birds. The goal of this interview is to gauge your interest in our lesson plan idea. We also hope to get feedback on how to make our plan useful for you and your students. Your participation in this survey is completely voluntary. Each question is optional, and you may stop this survey at any time. Please note that we will not disclose your name or any other identifying information unless you give us explicit permission otherwise. If interested a copy of our results can be provided through an internet link at the conclusion of the study. If you would like to contact our project team, please use our email alias: gr-birdslaplata@wpi.edu

Survey Questions:

1. What grade do you teach?
2. What school do you teach at?
3. Is the program described above something you could see yourself implementing?
4. What could we include to make this program better for you and your students?
5. Are there any obvious flaws in our initial project idea that we should address? For example, does asking your students to bird watch from home seem like a viable option or would some students experience setbacks?
6. Typically, how long are your science class periods? (if it changes day to day please give us an average or range)
7. Would you be interested in follow up questions from us, if necessary?
8. If you are interested in a follow up, please include your email address and your name.

Appendix C: Interview Massachusetts Middle School Teachers

Preamble: We are a team of third year undergrad students from Worcester Polytechnic Institute in Worcester, Massachusetts. From March until May, we are working with the Massachusetts Audubon Society to develop an educational program for students to learn about their local environment through bird watching. This program will align with the Massachusetts Middle School science standards in order to make it relevant to current courses. The program will include a field guide to learn more about different bird species. We will also create a checklist of Central Massachusetts birds that can be used alongside the field guide when bird watching to identify different birds. The goal of this interview is to help us gain more insight on how we can effectively deliver our lesson plan about birds and their ecosystems to middle school students. Please note that your answers will remain anonymous unless you give us permission otherwise. If interested a copy of our results can be provided through an internet link at the conclusion of the study. If you would like to contact our project team, please use our email alias: gr-birdslaplata@wpi.edu.

Interview Questions:

1. How do you structure your lesson plans?
2. What resources do you use to create a lesson plan?
3. What types of activities do you run with your students?
4. What resources do you use tAo find or create your activities with?
5. What are some successful past activities you have done?
6. How often do you take your students outside of the classroom to run an activity?
7. We plan to put our lesson on Natural Selection in the context of birds, such as by giving examples of symbiotic relationships involving bird species. Would you prefer the Natural Selection lesson to be more general or to focus mostly on birds?
8. In one of our lesson plans, there is an activity in which the teacher takes the students out to the school yard and look for any local birds and pretend to be an ornithologist;
    a. Does this sound like an activity that you would want to have your students to do?
    b. Do you think this would prove beneficial to the lesson?

c. What are some concerns and/or issues that you think might come up?

Appendix D: Interview Birders

Preamble: We are a team of third year undergrad students from Worcester Polytechnic Institute in Worcester, Massachusetts. From March until May, we are working with the Massachusetts Audubon Society to develop an educational program for students to learn about their local environment through bird watching. This program will align with the Massachusetts Middle School science standards in order to make it relevant to current courses. The program will include a field guide to learn more about different bird species. We will also create a checklist of Central Massachusetts birds that can be used alongside the field guide when bird watching to identify different birds. The goal of this interview is to learn what made you interested in bird watching and what resources you use while birdwatching. We also want to know if you have any introductory information on birds you recommend, we can include in our section. Please note that your answers will remain anonymous unless you give us permission otherwise. If interested a copy of our results can be provided through an internet link at the conclusion of the study. If you would like to contact our project team, please use our email alias: gr-birdslaplata@wpi.edu.

Interview Questions:

1. When did you start bird watching? What made you interested in birding?
2. What do you use to learn about the birds in an area before an outing?
3. What resources/equipment are necessary for you to bird watch? Do you own these resources?
4. How do you keep track of the birds you see in an outing?
5. What is the best way to find birds?
6. Do you know any introductory bird information we can include in our lesson plan?

Appendix E: Survey Massachusetts Student Teachers

Preamble: We are a team of third-year undergrad students from Worcester Polytechnic Institute in Worcester, Massachusetts. For the past few weeks, we have been working with the Massachusetts Audubon Society to develop an educational program for middle school students to learn about their local environment through bird watching. This program will align with the Massachusetts Middle School science standards. We have created a lesson plan which is split up over 5 days and includes lessons and activities in the classroom, as well as a day where students go outside the classroom and pretend to be ornithologists. Students will bird watch together in the schoolyard or a local park. The five days will consist of:

> Natural Selection and Evolution, Stations Activity on Evolution, Bird Identification, Reducing Environmental Impact, and an Outdoor Lesson.

Since we are new at creating lesson plans, we are looking for your feedback on the lesson plans that we have created for Days 1, 3, 4, and 5. We don't have a lesson plan for Day 2 only because it is a day for station activities we have not yet finished. Your participation in this survey is completely voluntary. Each question is optional, and you may stop this survey at any time. Please note that we will not disclose your name or any other identifying information unless you give us explicit permission otherwise. If interested a copy of our results can be provided through an internet link at the conclusion of the study. If you would like to contact our project team, please use our email alias: gr-birdslaplata@wpi.edu

Survey Questions:

1. Do you think the lessons were too short, just right, or too long for a 50-minute class period?
2. Did you feel the material and activities being taught were too young, just right, or too mature for middle school students?
3. Do you think the lessons are easy enough for the teachers to follow as well or are there more things we could have included to help the teacher?
4. What comments did you have about the lesson plan for Day 1: Natural Selection and Evolution?

5. What comments did you have about the lesson plan for Day 3: Bird ID?
6. What comments did you have about the lesson plan for Day 4: Reducing Environmental Impact?
7. What comments did you have about the lesson plan for Day 5: Act Like an Ornithologist?
8. What were some general comments you had on our lesson plans? What were some areas we could improve on?
9. Is there anything we forgot to include in our lesson plans or anything that could be added to our lessons that help enhance the material we are trying to teach the students?

Appendix F: Checklist of 50 Common Central Mass Bird Species

Central Massachusetts Checklist

50 common bird species

Jays, Crows, & Swallows:
- ❑ American Crow
- ❑ Barn Swallow
- ❑ Blue Jay
- ❑ Tree Swallow

Thrushes & Mimics:
- ❑ American Robin
- ❑ Eastern Bluebird
- ❑ Gray Catbird
- ❑ Northern Mockingbird

Chickadees, Titmice & Nuthatches:
- ❑ Black-capped Chickadee
- ❑ Tufted Titmouse
- ❑ White-breasted Nuthatch

Sparrows, Cardinals & Tanagers:
- ❑ Chipping Sparrow
- ❑ Scarlet Tanager
- ❑ Song Sparrow
- ❑ House Sparrow
- ❑ Northern Cardinal

Warblers:
- ❑ American Redstart
- ❑ Common Yellowthroat
- ❑ Ovenbird
- ❑ Yellow-rumped Warbler
- ❑ Yellow Warbler

Finches:
- ❑ American Goldfinch
- ❑ House Finch

Flycatchers:
- ❑ Eastern Phoebe

Starlings:
- ❑ European Starling

Wrens:
- ❑ Carolina Wren
- ❑ House Wren

Vireos:
- ❑ Red-eyed Vireo

Blackbirds & Orioles:
- ❑ Baltimore Oriole
- ❑ Brown-headed Cowbird
- ❑ Common Grackle
- ❑ Red-winged Blackbird

Grosbeaks:
- ❑ Rose-breasted Grosbeak

Pigeons:
- ❑ Mourning Dove
- ❑ Rock Pigeon

Woodpeckers:
- ❑ Downy Woodpecker
- ❑ Pileated Woodpecker

Vultures & Raptors:
- ❑ Bald Eagle
- ❑ Barred Owl
- ❑ Osprey
- ❑ Red-Shouldered Hawk
- ❑ Red-Tailed Hawk
- ❑ Turkey Vulture

Turkey:
- ❑ Wild Turkey

Hummingbirds:
- ❑ Ruby-throated Hummingbird

Waterfowl & Shorebirds:
- ❑ Hooded Merganser
- ❑ Mallard
- ❑ Ring-billed Gull
- ❑ Great blue heron
- ❑ Killdeer

Appendix G: Field Guide of Common Central Mass Bird Species

Central-Massachusetts Field Guide Common Bird Species

Table of Contents

How to use this Field Guide

A field guide is a bird watcher's most important tool. Field guides are made for many different states, regions, and countries. They contain vital information for identifying birds in the area by providing pictures and descriptions.

This field guide is filled with information about common birds found in Central-Massachusetts. It is organized by type of bird, with categories like "Finches" and "Vultures and Raptors". Each species has a picture and a description that includes certain features of the bird, like color patterns, size, and shape. Species with characteristic differences between males and females will have a picture for each sex. There is a frequency bar graph included for each species. The bar displays the times of year that the species is most frequently seen. The months with no frequency represent periods of migration for the species.

When you see a bird, you can identify it using your field guide. Simply search through the field guide to find a match. While looking for your bird, be sure to keep in mind the 4 steps to identifying a bird:

1. Size and Shape
2. Color
3. Behavior
4. Habitat

When you find your bird in your field guide, make sure all four of these characteristics match with what you saw.

If you are still having trouble identifying a bird through your field guide, it may be worth checking the Internet. You can use the Merlin Bird ID app or website to answer questions about the bird you saw in order to get a list of likely species. A simple Google search is often helpful as well. When searching for your bird online, make sure to include not only what the bird looks like, but where you found it (e.g. Massachusetts).

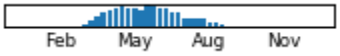
If you still cannot confidently identify your bird, do not try to guess what the bird was. Instead, you may want to mark down that you saw an unidentified bird. In that case, also be sure to write down a small description including what it looked like, or even draw a sketch.

Blue Jay (*Cyanocitta cristata)*:
Blue Jays measure just under a foot long from beak to tail tip, so they are among the larger backyard birds in Massachusetts. Blue Jays are pugnacious and highly vocal during the breeding season. They'll chase away fellow Blue Jays, other songbirds, hawks, owls, and even family pets, driving intruders from their territory with diving attacks and repeated volleys of their strident *jay! jay!* Call. Blue Jays can even mimic the scream of a Red-tailed Hawk in order to scare other birds! Blue Jays will eat a wide variety of plant and animal foods, but acorns are a particular favorite. They also won't pass up a freshly-stocked bird feeder filled with seeds!


Josh Lovering | 2020


Ian Hearn | Macaulay Library | 2017

Barn Swallow (*Hirundo rustica*):
Barn Swallows (6-7”) have a steely blue back, wings, and tail, and rufous to tawny underparts. The blue crown and face contrast with the cinnamon-colored forehead and throat. White spots under the tail can be difficult to see except in flight. Males are more boldly colored than females. Barn Swallows feed on the wing, snagging insects from just above the ground or water to heights of 100 feet or more. You can find the adaptable Barn Swallow feeding in open habitats from fields, parks, and roadway edges to marshes, meadows, ponds, and coastal waters.[1]




Greg Gillson | Macaulay Library | 2010

Tree Swallow (*Tachycineta bicolor*):
Adult males (4.7 - 5.9”) are blue-green above and white below with blackish flight feathers and a thin black eye mask; females are duller with more brown in their upperparts, and juveniles are completely brown above. Juveniles and some females can show a weak, blurry gray-brown breast band. Tree Swallows feed on small, aerial insects that they catch in their mouths during acrobatic flight. After breeding, Tree Swallows gather in large flocks to molt and migrate. In the nonbreeding season, they form huge communal roosts. Tree Swallows breed in open habitats such as fields and wetlands, usually adjacent to water. They nest in artificial nest boxes as well as tree cavities. Foraging flocks are frequently seen over wetlands, water, and agricultural fields.[1]


Noah Strycker | Macaulay Library | 2013

American Crow (*Corvus brachyrhynchos*):
Crows (15.8 - 20.9”) have long suffered under the reputation of being "bad." Crows raid crops, frequently steal eggs and chicks from other bird nests, and have been known to steal shiny objects such as articles of jewelry from people. Yet, these vocal black birds are among the most intelligent. Crow are said to be able to count (to a point) and they are also known to be very discriminating in their abilities to identify specific objects.
It is found in both urban and forested areas, in fields and pastures, and along coastal beaches. It’s a large black bird with long legs and a thick bill. Crows are almost completely omnivorous, meaning they eat a wide variety of food types including fruits, nuts, grains, insects, crustaceans, mollusks, amphibians, reptiles, small mammals, birds and their eggs and nestlings, garbage, and carrion (e.g., roadkills, dead fish, etc.).


Ryan Schain | Macaulay Library | 2012

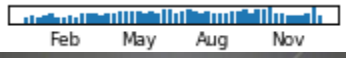
Ashley Bradford| Macaulay Library | 2017

American Robin (*Turdus migratorius*):
Both males and females are grey above and orange to brick-red below, and are of medium size (about 10" long). Their bills are yellow, and when a robin flies, it shows two small white tips at the corners of its dark tail. Very young robins will show a speckled breast rather than the adult red. During winter and migration especially, robins often travel in flocks, so it's not unusual to see a dozen or more birds foraging on the same lawn or perching in the same tree. During the warm months, a robin with an earthworm in its beak is a familiar sight. In addition to worms, they eat many insects and ground-dwelling larvae, as well as caterpillars, grasshoppers, and beetles.
In winter, robins are nomadic. They fly in flocks and eat the berries of trees and shrubs that hold their fruit through the winter.

Alix d'Entremont | Macaulay Library | 2017

Eastern Bluebird (*Sialia sialis*):
Eastern bluebirds (6.3 - 8.3") are easy to identify thanks to their bright blue backs and brick-red breasts. Some females may be rather subdued in coloration, to the point where their backs are blue-gray and their breasts only faintly rusty, but the pattern of colors remains the same. Bluebirds are smaller than blue jays, and they lack the pointed crests, black collars, and extensive white on the wings and tail that blue jays show.
In spring and summer, bluebirds nest in holes, either in trees or in birdhouses put up for their use. They mostly forage for insects on the ground, occasionally catching flying bugs on the wing. As the weather gets colder, many bluebirds flock together for migration. Those that remain in Massachusetts dine primarily on soft fruits, and a pair of bluebirds may remain on or near their breeding territory all through the winter.

Alix d'Entremont | Macaulay Library | 2017



Jay McGowan | Macaulay Library | 2016

Northern Mockingbird (*Mimus polyglottos*):
Mockingbirds have slender bodies, long tails, and short, straight bills. Bill to tail tip, an average individual measures 10". Northern mockingbirds are mostly an unremarkable gray, with pale breasts and stomachs and dark wings. When a mockingbird flies, it reveals bright white patterns on the wings and tail that serve as excellent field marks.
During the breeding season, northern mockingbirds are easy to see, whether singing from a prominent perch or pugnaciously chasing off rivals and competitors. Mockingbirds hunting insects will run along the ground, occasionally pausing and half-raising their boldly patterned wings in an effort to startle insects into flight. In the winter, mockingbirds often perch in evergreen shrubs or thick tangles that afford some protection from harsh weather, and their diet shifts to being dominated by berries and fruit.

Gray Catbird (*Dumetella carolinensis*):
A medium-sized (8.3 - 9.4"), slender songbird with a long, rounded, black tail and a narrow, straight bill. Catbirds are fairly long legged and have broad, rounded wings. Catbirds give the impression of being entirely slaty gray. With a closer look you'll see a small black cap, blackish tail, and a rich rufous-brown patch under the tail. Catbirds are secretive but energetic, hopping and fluttering from branch to branch through tangles of vegetation. Singing males sit atop shrubs and small trees. Catbirds are reluctant to fly across open areas, preferring quick, low flights over vegetation. Look for Gray Catbirds in dense tangles of shrubs, small trees, and vines, along forest edges, streamside thickets, old fields, and fencerows.[1]

Bryan Calk | Macaulay Library | 2017

Black-capped Chickadee (*Poecile atricapillus*):

Josh Lovering | 2020

Black-capped chickadees are small (just over five inches) and often appear large-headed and somewhat "fluffy." Their black caps and throats make a stark contrast with their white cheeks, forming a distinctive pattern. When feeding, chickadees are curious and active, taking advantage of their strong feet and small size to crawl to the very edges of twigs, sometimes hanging upside down to pick at a promising morsel.

Josh Lovering | 2020

Tufted Titmouse (*Baeolophus bicolor*):

From the neck down, tufted titmice look very similar to black-capped chickadees: pale gray above and white below, with rusty flanks. Their heads sport a small crest like a cardinal's, and their black eyes stand out in their otherwise unmarked pale faces.

Titmice are noticeably larger than chickadees, with more than an inch's difference in length between the two on average. Titmice have small but fairly thick bills, and many sport at least a small patch of black "nose" feathers above the maxilla (upper mandible).

White-Breasted Nuthatches (*Sitta carolinensis*):

White-breasted Nuthatches are just shy of six inches long. They are bluish-gray above, with black caps on their heads. Their faces, breasts, and bellies are white, with rusty coloration around the bird's vent. Their bills are fairly long and sharply pointed.

In addition to their distinctive habit of descending trees head-first, nuthatches will crawl all over tree trunks and larger branches, looking for food in the crevices.

Nuthatches tend to be more wary. They may hitch around to the opposite side of a tree to avoid a curious observer. And while they will readily visit feeders, nuthatches tend to collect just one seed at time and carry it off to handle and eat somewhere nearby.

David Turgeon | Macaulay Library | 2016

Northern Cardinal (*Cardinalis cardinalis*):

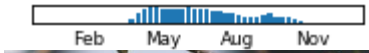
The male northern cardinal is unmistakable, thanks to his rose-red plumage, pointed crest, and black mask. The female cardinal has a more subdued fashion sense, preferring pale tan and brown with a few rosy accents on the crest, wing, and tail. Both sexes have the same heavy, bright orange bill.

Rather than walking, cardinals hop, whether on the ground or from branch to branch, and they eat a mixture of insects, plant buds, seeds, and fruits. Fruit and seeds predominate during fall and winter.

Josh Lovering | 2020

Josh Lovering | 2020

Chipping Sparrow (*Spizella passerina*):



Charles J. Lovering | 2020

Chipping sparrows are small sparrows (less than 6" from bill to tail) with chestnut caps and completely unmarked undersides. Their faces are cleanly outlined by a white eyebrow-stripe and a black line through the eye itself. No other sparrow in our area has these characteristics. Young chipping sparrows may have streaky breasts and bellies, but their small size and the frequent presence of nearby adults aid identification.

Like most sparrows, chipping sparrows are ground feeders. Chipping sparrows are often seen pecking through the leaf litter or brush on a road or path at the edge of the woods. If approached, rather than scattering for the trees, "chippies" will sometimes repeatedly fly further along the path and land again.

Ryan Schain | Macaulay Library | 2017

Song Sparrow (*Melospiza melodia*):

Song Sparrows are medium-sized (4.7 - 6.7") and fairly bulky sparrows. For a sparrow, the bill is short and stout and the head fairly rounded. The tail is long and rounded, and the wings are broad. Song Sparrows are streaky and brown with thick streaks on a white chest and flanks. On a closer look, the head is an attractive mix of warm red-brown and slaty gray, though these shades, as well as the amount of streaking, vary extensively across North America. Look for Song Sparrows in nearly any open habitat, including marsh edges, overgrown fields, backyards, desert washes, and forest edges. Song Sparrows commonly visit bird feeders and build nests in residential areas.[1]

House Sparrow (*Passer domesticus*):

Douglas Faulder | Macaulay Library | 2017

(6 - 6.7") Male House Sparrows are brightly colored birds with gray heads, white cheeks, a black bib, and rufous neck – although in cities you may see some that are dull and grubby. Females are a plain buffy-brown overall with dingy gray-brown underparts. Their backs are noticeably striped with buff, black, and brown.

Evan Lipton | Macaulay Library | 2015

House Sparrows are noisy sparrows that flutter down from eaves and fencerows to hop and peck at crumbs or birdseed. House Sparrows have lived around humans for centuries. Look for them on city streets, taking handouts in parks and zoos, or cheeping from a perch on your roof or trees in your yard. House Sparrows are absent from undisturbed forests and grasslands, but they're common in countryside around farmsteads.[1]

Andrew Spencer| Macaulay Library | 2015

Scarlet Tanager (*Piranga olivacea*):

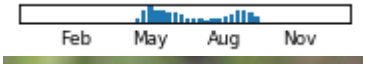
Scarlet Tanagers are medium-sized (6.4 - 6.7") songbirds with fairly stocky proportions. They have thick, rounded bills suitable both for catching insects and eating fruit. The head is fairly large and the tail is somewhat short and broad. In spring and summer, adult males are an unmistakable, brilliant red with black wings and tails. Females and fall immatures are olive-yellow with darker olive wings and tails. After breeding, adult males molt to female-like plumage, but with black wings and tail. Primarily insectivorous during the summer, Scarlet Tanagers also eat fruit during migration and on the wintering grounds. Scarlet Tanagers breed in deciduous and mixed deciduous-evergreen forests in eastern North America. They are somewhat sensitive to habitat fragmentation, so look for them in large, undisturbed tracts of forest. During migration, they move through a broader variety of forest and shrubby habitats, as well as backyards.[1]

Mike V.A. Burrell | Macaulay Library | 2016

American Redstart (*Steophaga ruticilla*):

Adult male American Redstarts (4-5") are mostly black with bright orange patches on the sides, wings, and tail. The belly is white. Females and immature males replace the orange with yellow or yellow-orange. They have gray head and underparts, with olive back and wings and dark-gray tail.

Jeremiah Trimble | Macaulay Library | 2016



Evan Lipton | Macaulay Library | 2016

American Redstarts are incredibly active insectivores that seem never to stand still. American Redstarts breed in open wooded habitats, particularly those dominated by deciduous trees. In migration, the species can be found in nearly any treed habitats. Its tropical winter habitat is in woodlands and open forest at lower and middle elevations.[1]

Blue-winged Warbler (*Vermivora cyanoptera*):

Adult males (4.5") are bright yellow below, yellow-green above, and have two obvious wingbars on blue-gray wings, and a black eyeline. Adult females are paler with a less defined eyeline. The black bill and eyeline contribute to an almost angry-looking expression. From below look for the white undertail coverts on both sexes.

These warblers dangle from shrubs much like a chickadee, often foraging upside down and picking insects from dead leaves. Blue-winged Warbler is a shrubland specialist, and are found in brushy fields, thickets, and forest edges.[1]

Joseph Pescatore | Macaulay Library | 2015

Common Yellowthroat (*Geothlypis trichas*):

Common Yellowthroats are between 4 and 5 inches long. Adult males are bright yellow below, with a sharp black face mask and olive upperparts. A thin whitish line sets off the black mask from the head and neck. Immature males show traces of the full mask of adult males. Females are a plain olive brown, usually with yellow brightening the throat and under the tail. They lack the black mask.

David Turgeon | Macaulay Library | 2017

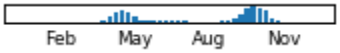
Common Yellowthroats spend much of their time skulking low to the ground in dense thickets and fields, searching for small insects and spiders.

Yellowthroats live in open areas with thick, low vegetation, ranging from marsh to grassland to open pine forest.[1]

David Turgeon | Macaulay Library | 2017

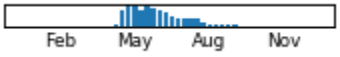
Yellow-rumped Warbler (*Setophaga coronata*):

In summer, both sexes (4.5-5.5") are a smart gray with flashes of white in the wings and yellow on the face, sides, and rump. Males are very strikingly shaded; females are duller and may show some brown. Winter birds are paler brown, with bright yellow rump and usually some yellow on the sides. Yellow-rumped Warblers typically forage in the outer tree canopies at middle heights. They're active, and you'll often see them sally out to catch insects in midair, sometimes on long flights. In winter they spend lots of time eating berries from shrubs, and they often travel in large flocks.[1]



Ryan Schain | Macaulay Library | 2010

Yellow Warbler (*Setophaga petechia*):



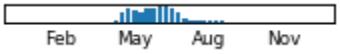
Ryan Schain | Macaulay Library | 2011

Yellow Warblers are small (4.7 - 5.1"), evenly proportioned songbirds with medium-length tails and rounded heads. For a warbler, the straight, thin bill is relatively large. Yellow Warblers are uniformly yellow birds. Males are a bright, egg-yolk yellow with reddish streaks on the underparts. Both sexes flash yellow patches in the tail. The face is unmarked, accentuating the large black eye. Look for Yellow Warblers near the tops of tall shrubs and small trees. They forage restlessly, with quick hops along small branches and twigs to glean caterpillars and other insects. Males sing their sweet, whistled songs from high perches. Yellow Warblers breed in shrubby thickets and woods, particularly along watercourses and in wetlands. Common trees include willows, alders, and cottonwoods across North America and up to about 9,000 feet in the West. In winter they mainly occur in mangrove forests of Central and South America.[1]

Ovenbird (*Seiurus aurocapilla*):

Ovenbirds (4-5.5") are olive-green above and spotted below, with bold black-and-orange crown stripes. A white eyering gives it a somewhat surprised expression. Like several other terrestrial, or near-terrestrial, warblers, Ovenbirds have pink legs.

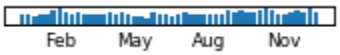
Ovenbirds spend much of their time foraging on the ground, often walking with a herky-jerky, wandering stroll that is unlike most terrestrial songbirds. Ovenbirds breed in closed-canopy forests, particularly deciduous and mixed deciduous-coniferous woods. You may find them in most forest types, from rich oak or maple woods to dry pine forest, although they avoid wet or swampy areas.[1]



Don Blecha | Macaulay Library | 2016

Suzanne Labbé | Macaulay Library | 2017

House Finch (*Haemorhous mexicanus*):
(5.1 - 5.5") Adult males are rosy red around the face and upper breast, with streaky brown back, belly and tail. In flight, the red rump is conspicuous. Adult females aren't red; they are plain grayish-brown with thick, blurry streaks and an indistinctly marked face. House Finches are gregarious birds that collect at feeders or perch high in nearby trees. When they're not at feeders, they feed on the ground, on weed stalks, or in trees.
House Finches frequent city parks, backyards, urban centers, farms, and forest edges across the continent. In the western U.S., you'll also find House Finches in their native habitats of deserts, grassland, chaparral, and open woods.[1]

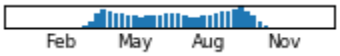


Dave Spier | Macaulay Library | 2008

Adam Jackson | Macaulay Library | 2016

American Goldfinch (*Spinus tristis)*:
Called sometimes the "wild canary" of the Americas, the American goldfinch's distinctive sunshine-yellow plumage (feathers) fades in winter to an understated palette of gray, brown, and buff. Regardless of season, several traits about goldfinches remain constant. American goldfinches are small (5") seed-eating birds with short, pointed, conical bills and wings that are noticeably darker than their bodies. Goldfinches often travel in flocks, and they have a recognizable "bouncing" style of flight, resulting from their tendency to hold their wings tight against their body for a second or two between bouts of flapping.

Jay McGowan | Macaulay Library | 2016



Epi Shemming | Macaulay Library | 2017

Eastern Phoebe (*Sayornis phoebe*):
The Eastern Phoebe (5.5 - 6.7") is a plump songbird with a medium-length tail. It appears large-headed for a bird of its size. The head often appears flat on top, but phoebes sometimes raise the feathers up into a peak. Like most small flycatchers, they have short, thin bills used for catching insects. The Eastern Phoebe is brownish-gray above and off-white below, with a dusky wash to the sides of the breast. The head is typically the darkest part of the upperparts. Birds in fresh fall plumage show faint yellow on the belly and whitish edging on the folded wing feathers. The Eastern Phoebe generally perches low in trees or on fencelines. These birds favor open woods such as yards, parks, woodlands, and woodland edges. Phoebes usually breed around buildings or bridges on which they construct their nests under the protection of an eave or ledge.[1]

European Starling (*Sturnus vulgaris*):

At more than eight inches from bill to tail tip, starlings are noticeably larger than sparrows but don't quite measure up to robins or blue jays. Starlings have short, stubby tails, and their fairly long, straight bills are banana yellow during the breeding season and gray-black at other times of the year. Adult European starlings show glossy black plumage with numerous light spangles during the winter, but these wear off by the time breeding begins, and the iridescent black feathers reflect shades of green and violet. Juvenile starlings are a uniform drab brown.

Starlings are exceptionally gregarious, flocking (often in great numbers) at all times of the year. When feeding, starlings often rove across the ground with determined steps, using their long, strong bills to probe and pry at the soil for invertebrate prey. They will also consume seeds.

Dan Vickers | Macaulay Library | 2017

Evan Lipton | Macaulay Library | 2014

Carolina Wren (*Thryothorus ludovicianus*):

Like most wrens, Carolina wrens are small (5.5") brown birds with fairly short tails that they often hold cocked upward. Their bills are well-suited for probing for insects, being long, pointed, and slightly decurved.

Although they do not flock, Carolina wrens have strong pair-bonds, and a mated pair will often remain together on the same territory year-round. They do take fruits and weed seeds (from plants like smartweeds and sumacs) in winter, though they seldom come to bird feeders.

House Wren (*Troglodytes aedon*):

Small and compact (4.3 - 5.1"), with a flat head and fairly long, curved beak. Short-winged, often keeping its longish tail either cocked above the line of the body or slightly drooped. Smaller than a Carolina Wren; chickadee-sized. Subdued brown overall with darker barring on the wings and tail. The pale eyebrow that is characteristic of so many wren species is much fainter in House Wrens. Bubbly and energetic, just like their songs. Look for House Wrens hopping quickly through tangles and low branches and, in spring and summer, frequently pausing to deliver cheerful trilling songs. In summer, House Wrens are at home in open forests, forest edges, and areas with scattered grass and trees. Backyards, farmyards, and city parks are perfect for them. In winter they become more secretive, preferring brushy tangles, thickets, and hedgerows.[1]

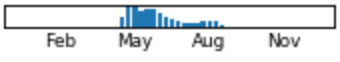
Andy Witchger | Macaulay Library | 2017

Red-eyed Vireo (*Vireo olivaceus*):

Jim Hully | Macaulay Library | 2016

Red-eyed Vireos (4.7 - 5.1") are large, chunky vireos with a long, angular head, thick neck, and a strong, long bill with a small but noticeable hook at the tip. The body is stocky and the tail fairly short. Slightly larger than a Yellow Warbler; slightly smaller than a Tufted Titmouse. Red-eyed Vireos are olive-green above and clean white below with a strong head pattern: a gray crown and white eyebrow stripe bordered above and below by blackish lines. The flanks and under the tail have a green-yellow wash. Adults have red eyes that appear dark from a distance; immatures have dark eyes. Large expanses of deciduous forest, particularly deciduous trees with large leaves (such as maples), typify Red-eyed Vireo habitat during the breeding season. On migration, look for them in nearly any type of forest, woodland, or woodlot (particularly in deciduous stands). It is often the commonest of vireo migrants. [1]

Baltimore Oriole (*Icterus galbula*):



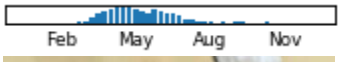
Jack & Holly Bartholmai | Macaulay Library | 2011

Smaller and more slender than an American Robin, Baltimore Orioles (4.7 - 7.5") are medium-sized, sturdy-bodied songbirds with thick necks and long legs. Look for their long, thick-based, pointed bills, a hallmark of the blackbird family they belong to. Adult males are flame-orange and black, with a solid-black head and one white bar on their black wings. Females and immature males are yellow-orange on the breast, grayish on the head and back, with two bold white wing bars. Baltimore Orioles are more often heard than seen as they feed high in trees, searching leaves and small branches for insects, flowers, and fruit. Look for Baltimore Orioles high in leafy deciduous trees, but not in deep forests: they're found in open woodland, forest edge, orchards, and stands of trees along rivers, in parks, and in backyards.[1]

Ryan Schain | Macaulay Library | 2011

Brown-headed Cowbird (*Molothrus ater)*:

The male brown-headed cowbird is shiny black all over, save for his head, which is (as might be expected) chocolate brown. The female is drab gray-brown all over, with faint or no streaking. She can be recognized by her stout build, strong, pointed bill, and slightly notched tail. This species is a nest parasite—female cowbirds never build nests of their own, instead laying their eggs in the nests of other species such as finches and warblers. These "host" birds may eject the cowbird egg, abandon the nest, or raise it as their own. A baby cowbird often grows more quickly than its nestmates, crowding them out of the nest and eventually dwarfing its adoptive parent.

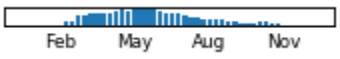


Arlene Ripley | Macaulay Library | 2017

Brian Sullivan | Macaulay Library | 2008

Common Grackle (*Quiscalus quiscula)*:

This species is the largest member of the blackbird clan that regularly occurs in Massachusetts. Grackles of both sexes are entirely shiny black, with patches of green and purple gloss. Their slightly-downcurved bills are long and dark, and their pale eyes stand out at quite some distance. The best field mark for separating grackles from other blackbirds and similar species like starlings is the tail. Grackles have long, wedge-shaped tails that are especially visible in flight. Grackles are also quite large, exceeding a foot in length from bill to tail.



Evan Lipton | Macaulay Library | 2015

T I | Macaulay Library | 2017

Phil Kahler | Macaulay Library | 2017

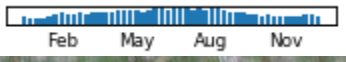
Red-winged Blackbird (*Agelaius phoeniceus)*:
Red-winged blackbirds are smaller than robins but larger than sparrows, coming in at just below 9" in length. Both sexes have sharp black bills, but their plumages are quite distinct.
Males are solid black with red shoulder patches. The shoulder patches are bordered with a line of yellow at the bottom, and the birds can conceal the shoulder patches when they wish, leaving only the thin line visible. Females resemble large sparrows, but can be recognized as this species by their sharp bills, orange-washed faces, and heavy, regular streaking below.
During spring and summer especially, red-winged blackbirds are quintessential marsh birds. Even small ponds and wet culverts may host a pair or two nesting in the reedy growth. In fall, like most blackbirds, red-wings gather into large flocks and forage for grain and insects across open areas.

David Trescak | Macaulay Library | 2017

Deborah Bifulco | Macaulay Library | 2017

Rose-breasted Grosbeak (*Pheucticus ludovicianus*):
Rose-breasted Grosbeaks (7.1 - 8.3") are stocky, medium-sized songbirds with very large triangular bills. They are broad-chested, with a short neck and a medium-length, squared tail. Smaller than an American Robin; larger than a House Finch. Adult males are black-and-white birds with a brilliant red chevron extending from the black throat down the middle of the breast. Females and immatures are brown and heavily streaked, with a bold whitish stripe over the eye. Males flash pink-red under the wings; females flash yellowish. Both sexes show white patches in the wings and tail. These chunky birds use their stout bills to eat seeds, fruit, and insects. They are also frequent visitors to backyard bird feeders, where they eat sunflower seeds with abandon. Rose-breasted Grosbeaks breed in eastern forests; you can find them among both deciduous trees and conifers. They are most common in regenerating woodlands and often concentrate along forest edges and in parks. During migration, Rose-breasted Grosbeaks frequent fruiting trees to help fuel their flights to Central and South America.[1]

James Kinderman | Macaulay Library | 2017



Josh Lovering | 2020

Mourning Dove (*Zenaida macroura*):
Mourning doves of both sexes are cleanly attired in soft browns and grays. Their wings bear a few black spots, and most show a small gray or black dash on their cheeks. They are larger than most backyard birds, measuring a foot from bill to tail tip. The bill is small and straight; the tail long and pointed. Their white outer tail feathers are clearly visible from behind when the birds take wing.
Flocks of doves are often seen during the fall migration and through the winter, foraging for seeds below bird feeders or in agricultural fields. They also often perch in dead trees or on telephone wires.

Rock Pigeon (*Columba livia*):
They have plump bodies, short legs, and thin, relatively short beaks. Their tails are fan-shaped and their wings are pointed. Through selective breeding, people have developed domestic pigeon varieties with many interesting patterns and colors, much like domestic dog or horse breeds. This is why the descendants of these birds, the feral pigeons, can be found in many shades of brown, gray, black, and white. However, most flocks contain individuals with the typical wild "blue" form: a blue-gray body, lighter blue-gray wings marked by two black bands, a wide black tail band, and a white rump. The neck often shimmers with purple and green iridescent feathers. Pigeons are flocking birds, and they are among the strongest and swiftest of avian fliers. Their flight muscles make up about one-third of the total body weight. Some birds are raised for racing; they may fly more than 500 miles in a single day and have been clocked at speeds in excess of 94 miles per hour.

Luke Seitz | Macaulay Library | 2014

Downy woodpecker (*Picoides pubescens*):
Downy woodpeckers are small for woodpeckers but medium-sized as backyard birds go (just under 7" long, on average). Their backs have a broad white stripe down the center, and their black wings are marked with white horizontal bars. Their faces are also striped black-and-white, and males show a bright red dot at the backs of their heads.
Downy woodpecker bills are small but sharp and stout, like the point of a chisel. Their cousins, the hairy woodpeckers, look almost identical, but they are larger, with longer bills that are easily the length of their heads.
Downies will pick and peck at tree bark in search of insects, and they will often crawl out to the tips of smaller branches that larger woodpeckers can't access. They will eagerly visit feeders for both seeds and suet. In winter, they join large flocks of chickadees and nuthatches to search the landscape for food. In spring and summer, they nest in tree cavities, especially in soft or rotting wood that their small bills can excavate.

Charles J. Lovering | 2020

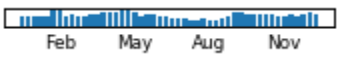
David Turgeon | Macaulay Library | 2017

Pileated woodpecker (*Dryocopus pileatus*):
The energetic, crow-sized pileated woodpecker is always a remarkable sight. It has a bright red crest and a black body with white patches on its wings. Look for the large rectangular holes that it excavates in trees to find carpenter ants, its preferred food.
Listen for a powerful drumming that is slow at first, then speeds up, and then slows again.

Dan Vickers | Macaulay Library | 2017

Carl Giometti | Macaulay Library | 2017

Red-Bellied woodpecker (*Melanerpes carolinus*):
This bird has only become common in Massachusetts during the past two decades. Despite the name, the most visible area of red on this bird can be found on its head and nape. It's slightly larger than a downy woodpecker and has beige underparts and a black and white barred back. This bird inhabits many types of forests and will visit feeders. Listen for a variety of sounds, from trills to loud chuckles to a steady drumming.



Barred Owl (*Strix varia*):

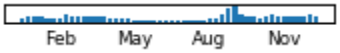
Barred Owls (16.9 - 19.7") are large, stocky owls with rounded heads, no ear tufts, and medium length, rounded tails. Smaller than a Great Horned Owl; larger than a Barn Owl. Barred Owls are mottled brown and white overall, with dark brown, almost black, eyes. The underparts are mostly marked with vertical brown bars on a white background, while the upper breast is crossed with horizontal brown bars. The wings and tail are barred brown and white. Barred Owls roost quietly in forest trees during the day, though they can occasionally be heard calling in daylight hours. At night they hunt small animals, especially rodents, and give an instantly recognizable "Who cooks for you?" call. Barred Owls live in large, mature forests made up of both deciduous trees and evergreens, often near water. They nest in tree cavities. In the Northwest, Barred Owls have moved into old-growth coniferous forest, where they compete with the threatened Spotted Owl.[1]

Frank Lovering | 2020

Steven Mlodinow | Macaulay Library | 2017

Bald Eagle (*Haliaeetus leucocephalus*):

Despite Benjamin Franklin's insistence that the Wild Turkey would have been a more appropriate choice, the Bald Eagle has been the symbol of the United States of America since its inception and it has symbolized courage, strength, ferocity, and freedom through the years. In reality, though, Bald Eagles often prefer to scavenge carrion when it is available rather than catch their own prey. What they cannot scavenge, they may steal from other birds. When they cannot scavenge or steal, eagles hunt for live prey, most often fish, but they will also feed on a wide variety of other animals as well.



Red-shouldered Hawk (*Buteo lineatus*):

In spring, as hopeful little creatures emerge from their winter haunts to forage on the new greenery, some will inevitably be eaten in their turn by Red-shouldered Hawks. Red-shouldered Hawks are among the earliest of our migrant species to return to New England in the spring; in fact, some of them remain with us all winter long. They are not as ubiquitous as their Red-tailed cousins, but there are still many that call the Bay State home. Usually encountered near areas of wet woods, Red-shouldered Hawks readily take fish and amphibians in addition to more typical hawk fare such as small mammals and occasionally birds.

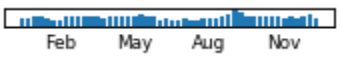
Chris S. Wood | Macaulay Library | 2017

Jonathan Eckerson | Macaulay Library | 2017

Red-tailed Hawk (*Buteo jamaicensis*):

With their broad wings, stocky build, and high-soaring habits, Red-tailed Hawks are very much the archetypal buteos. No hawk is more familiar to the casual birder in Massachusetts than this species, which can be found all across the Commonwealth.

Red-tailed Hawks are masters of soaring, and, consequently, they make countless, slow, spiral circles in search of prey, in defense of territory, and during courtship. When courting, the birds sometimes dive and swoop at each other, or even grapple in midair with a grace that seemingly is impossible for so large a bird.



Osprey (*Pandion haliaetus*):

Ospreys are brown above and white below, and overall they are whiter than most raptors. From below, the wings are mostly white with a prominent dark patch at the wrists. The head is white with a broad brown stripe through the eye. Juveniles have white spots on the back and buffy shading on the breast. Ospreys search for fish by flying on steady wingbeats and bowed wings or circling high in the sky over relatively shallow water. They often hover briefly before diving, feet first, to grab a fish. Look for Ospreys around nearly any body of water: saltmarshes, rivers, ponds, reservoirs, estuaries, and even coral reefs. Their conspicuous stick nests are placed in the open on poles, channel markers, and dead trees, often over water.[1]

Jay McGowan | Macaulay Library | 2015

Beth and Dan Fedorko | Macaulay Library | 2017

Turkey Vulture (*Cathartes aura*):

Matt Davis| Macaulay Library | 2017

Turkey vultures are large birds with nearly 6-foot wingspans. In flight, they look very dark, and their wings are two-toned, with a pale gray trailing edge. To distinguish turkey vultures from other soaring birds such as eagles or hawks, look for their relatively tiny heads, and note that they hold their wings above their bodies in a shallow "V". They also have a distinctive wobbly soaring style.

Turkey vultures are named for their resemblance to wild turkeys. When you encounter perching vultures, you can see why: like turkeys, their bodies are bulky, and their small heads are featherless and bright pink-red.

Dozens of birds may roost together. Turkey vultures specialize in eating carrion (dead animals). They have a well-developed sense of smell that they use to find food. Their heads are naked so that they can reach inside a carcass without contaminating their feathers.

Brian McKenny | Macaulay Library | 2017

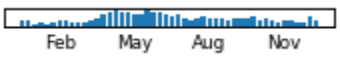
Wild Turkey (*Meleagris gallopavo*):

A Wild Turkey can stand four feet tall, with a large, bulky body covered with bronzy, iridescent feathers. The tom (male) has a reddish blue head and a hair-like "beard" protruding from the breast. The smaller female is duller in coloration than the male.

Adults feed largely on plant material, including nuts, berries, grains, seeds, grass, roots, and bulbs, but they will also supplement their diet with small invertebrates. The young feed mainly on insects.

In the spring, tom turkeys make their famous gobble in order to lure in females. Courtship begins when the tom spreads its tail, fluffs out its feathers, swells out the facial wattles, and struts in front of the females. Males are polygamous, and will mate with several females if given the opportunity. Wild Turkeys can fly for short distances up to 55 miles per hour. Not only can turkeys fly, they also roost in trees at night!

D. Bruce Yolton | Macaulay Library | 2017



Ruby-throated Hummingbird (*Archilochus colubris*):

Cathy Pondelicek | Macaulay Library | 2015

Ruby-throated Hummingbirds (2.5 - 3.5") are bright emerald or golden-green on the back and crown, with gray-white underparts. Males have a brilliant iridescent red throat that looks dark when it's not in good light.

Ruby-throated Hummingbirds fly straight and fast but can stop instantly, hover, and adjust their position up, down, or backwards with exquisite control. They often visit hummingbird feeders and tube-shaped flowers and defend these food sources against others. You may also see them plucking tiny insects from the air or from spider webs. Ruby-throated Hummingbirds live in open woodlands, forest edges, meadows, grasslands, and in parks, gardens, and backyards.[1]

Ian Davies | Macaulay Library | 2015

Killdeer (*Charadrius vociferus*):

Davey Walters | Macaulay Library | 2016

Killdeer (7.9 - 11.0")have the characteristic large, round head, large eye, and short bill of all plovers. They are especially slender and lanky, with a long, pointed tail and long wings. Similar in size to American Robin, but with longer legs and wings. Brownish-tan on top and white below. The white chest is barred with two black bands, and the brown face is marked with black and white patches. The bright orange-buff rump is conspicuous in flight. Look for Killdeer on open ground with low vegetation (or no vegetation at all), including lawns, golf courses, driveways, parking lots, and gravel-covered roofs, as well as pastures, fields, sandbars and mudflats. This species is one of the least water-associated of all shorebirds.[1]

Jeremy Collison | Macaulay Library | 2017

Ring-billed gull (*Larus delawarensis*):

The smallest of our common gulls (17.5"), the ring-billed gull has a gray back, gray wings with black tips, and white head, yellowish legs, and bill with a dark band near the tip. Ring-billed gulls, which are most commonly seen in central Massachusetts, have never successfully bred in Massachusetts. Gulls are opportunistic feeders, exploiting virtually any food source they can find.

Liron Gertsman | Macaulay Library | 2015

Mallard (*Anas platyrhynchos*):

Male Mallards are easily identified by the lustrous green head, while the more demure female is brown. They can be seen in parks and ponds in large numbers in fall and winter, but will break off into pairs when breeding season comes.

A Mallard's primary diet consists of vegetable matter such as grains, acorns, and aquatic vegetation. But in the breeding season, their diet shifts to encompass more animal matter such as insects, snails, minnows, and shrimp.

Steeve R. Baker | Macaulay Library | 2017

Hooded Merganser (*Lophodytes cucullatus*):

Adult male Hooded Mergansers are black above, with a white breast and rich chestnut flanks. The black head has a large white patch that varies in size when the crest is raised or lowered, but is always prominent. Females and immatures are gray and brown, with warm tawny-cinnamon tones on the head. Hooded Mergansers dive to catch aquatic insects, crayfish, and small fish. Look for Hooded Mergansers on small bodies of freshwater. In summer, these small ducks nest in holes in trees, often near freshwater ponds or rivers. For winter, they move to larger bodies of freshwater, marshes, and protected saltwater bays.[1]

Ryan Schain | Macaulay Library | 2017

Jay McGowan | Macaulay Library | 2017

Great Blue Heron (*Ardea herodias*):

Great Blue Herons (roughly 40") appear blue-gray from a distance, with a wide black stripe over the eye. In flight, the upper side of the wing is two-toned: pale on the forewing and darker on the flight feathers. A pure white subspecies occurs in coastal southern Florida. Hunting Great Blue Herons wade slowly or stand statue-like, stalking fish and other prey in shallow water or open fields.

Look for Great Blue Herons in saltwater and freshwater habitats, from open coasts, marshes, sloughs, riverbanks, and lakes to backyard goldfish ponds. They also forage in grasslands and agricultural fields. Breeding birds gather in colonies or "heronries" to build stick nests high off the ground.

Janis Stone | Macaulay Library | 2017

Happy Birding!

This field guide was produced in coordination with Mass Audubon. Many of the species descriptions were reproduced, from their website, with their permission. All of the species descriptions in this field guide were taken from the following sources:

- **Cornell Lab of Ornithology** - Allaboutbirds.org
  - A majority of the bird descriptions were quoted from this resource.
- **Mass Audubon** - https://www.massaudubon.org/learn/nature-wildlife/birds
  - Mass Audubon sponsored the creation of this field guide and permitted the reproduction of many of the bird descriptions included.
- **Ebird** - https://ebird.org/barchart?r=US-MA-027&yr=all&m=
  - The data used to create the frequency bars is an accumulation of user sightings posted data downloaded from the Ebird website.

[1] The Cornell Lab of Ornithology. (n.d). *Welcome to Our Bird Guide*. All About Birds. https://www.allaboutbirds.org/guide

Appendix H: Lesson 1

Slide 1: Intro

- Natural Selection, Evolution, Interspecies Relationships
- You could poll the class and see if the students already have an idea about these topics.
    - Optional Question: Who has heard of these topics and does anyone want to share what they think they are?

Slide 2: Hook

- Two short videos
    - First video shows a Bald Eagle catching a fish.
    - Second video shows Chickens eating corn. (You don't have to play the whole video)
- The videos are supposed to show the drastic variation in bird species.
    - How they get their food
    - How, or if they fly
    - Beaks
    - Feet
- Optional Brainstorm
    - Could use Post-its or whiteboards to have students come up with different features of birds.

Slide 3: Bird Feet

- Shows the variation in bird feet.
- Question(s): Why do the feet of each species look the way they do? How does this affect their survival?
    - Answer: Different species have different types of feet to fulfil different tasks. If the eagle didn't have strong and sharp talons it couldn't catch prey (this extends to the other species as well).
    - Sandpiper: Large surface area to walk on mud
    - Eagles: Strong sharp talons for grasping prey
    - Perching Sparrow: For perching on branches(away from predators)
    - Woodpecker: Gripping onto bark
    - Pigeon: Hopping around and clinging onto branches
    - Duck: Paddling in water

Slide 4: Bird Feet Pictures

- Real life examples of the feet studied in the last slide.
- Have the kids spot the different characteristics in the photos.

Slide 5: Bird Beaks

- Shows Darwin's Finches as well as a picture of a Bald Eagle and Griffin Vulture
- Question: Why do the birds' beaks look the way they do?
    - Answer: Their beaks serve as their main tool for getting food. Point out Darwin's finches. Specify that the bird with the larger/stronger looking beak uses it to crack nuts and the birds with thinner beaks have the agility to catch insects.
- Question: Is it a coincidence the Eagle and Vulture have similar shaped beaks?
    - Answer: No, both the Eagle and Vulture are carnivorous. This means they eat meat. Since their diet is so similar, their beaks have evolved to also be similar.

Slide 6: Evolution Video

- Video details the basics of Darwin's discoveries in the Galapagos Islands.
- Describes the theory of evolution by natural selection.

Slide 7: Key Evolution Points

- This slide has a lot of words and therefore might be challenging for the students.
- It summarizes key points from the video about how evolution by natural selection occurs
    - The genetic information of the parent organisms mix to create unique offspring.
    - The mixing causes the offspring to have slight differences in their characteristics.
    - If the differences in their characteristics help them survive in their particular environment then it is more likely they will have offspring themselves.
    - This pattern keeps repeating over hundreds of thousands or millions of years until there are vast differences in organisms and multiple different species.

Slide 8: Migration

- American Tree Sparrow migration map.
- They breed in far northern North America and migrate to northern and central North America for winter.
- They reach as far south as Arizona, Texas, and Alabama.

Slide 9: Bird Courtship

- Questions are answered on slide 10.
- The bird shown on the left side of the slide is a Red Cardinal.
- The video shows bird courtship dances and is very entertaining and funny.

Slide 10: Answers to Slide 9

- The bright colors of the males are an example of evolution due to the harsh selective pressure from the females.
    - In simpler words, female birds like the bright colors of the males so the ones who do not have bright colors do not reproduce
- This type of selection generates species where the males become brightly colored and the females don't.

- Question: What is the main advantage of females having dull colors?
    - Answer: Blending into their environment while sitting on the nest.
        - Hiding from predators.
- A Deeper Question: Why are females attracted to the bright colors in males?
    - Signifies a healthy bird.
- Example on the right side of the slide of male and female house sparrows that do not follow the trend of brightly colored males.

Slide 11 AND 12: Concept Check with Albatross and Hummingbird

- Optional: Break up of the students into groups so they can brainstorm why the birds evolved in the way they did.
    - They can then share their theories with the class
- Question: Why did the Albatros evolve to have such large wings?
    - Answer: Albatrosses eat fish, plankton, and crustactions. These resources are often found far out at sea. Therefore Albatrosses have to fly tens of thousands of miles out to sea to catch their prey.
    - By just using the wind, they can even glide for hundreds to thousands of miles without even a flap of their wings.
- Question: Why did the Sword-billed Hummingbird evolve to have such a long beak?
    - Answer: The humming bird mostly feeds on nectar from flowers. Some of the flowers such as the Datura have long, narrow necks. The nectar from these flowers is only accessible with a long narrow beak. Picture of Datura on Slide 13

Slide 13: Picture of Datura

Slide 14: Interspecies Relationships

- An easy example that the students will be familiar with is the interspecies relationship between humans and dogs.
- Question: Why did humans first start to keep dogs as pets?
    - Answer: Dogs helped give humans protection as well as helped in catching animals that humans and dogs both eat. Also, they served as an alarm system to warn humans of danger.
- Question: Is this interspecies relationship helpful to both humans and dogs?
    - Yes, Humans get protection and help catching animals while the dogs get food from the animals they help catch.

Slide 15: 5 Types of Interspecies Relationships

- Competition, Predation, Mutualism, Parasitism, Commensalism
- Explain what the + and - mean under each relation
    - The plus means it helps the organism and the minus means it hurts the organism

Slide 16: Competition

- Organisms compete for the same resource
    - Example: Downy Woodpeckers compete with squirrels for nesting territory in trees.

- Question: What are other resources that organisms could compete for?

Slide 17: Predation

- Example: Bald Eagle and Fish
- Question: Can you think of any other examples?

Slide 18: Mutualism

- Both organisms benefit from the exchange.
    - Example: Egyption Plover Bird eats the leftover food from inside the mouth of the Nile Crocodile.
- Video shows this very clearly but has funny music.

Slide 19: Parasitism

- One organism benefits at the detriment of the other.
- Question: Can you think of any common parasites? Maybe ones you check yourself for after a hike?
    - Answer: Ticks
- Brood Parasitism
    - A bird lays its egg in another birds nest
        - This causes the host bird to expend energy raising a bird that will not pass on its genes
            - Detrimental to the host but beneficial to parasite bird
            - Since the parent of the parasite bird does not have to expend energy raising a baby bird it can spend more energy creating more eggs and mating so it can reproduce more often.

Slide 20: Commensalism

- One organism benefits while the other is neither harmed nor helped
    - Example: Birds nesting in trees
- Question: Can you figure out which organism benefits and which is neither harmed nor helped?
    - Answer: Birds benefit because the tree provides protection from predators. The tree is neither harmed nor helped.

Appendix I: Lesson 2

All About Bill – Station 1

Materials:

1 large bowl
4-6 cups (1 per student + 1 extra)
Water
Marbles
Beads
Bits of string
Paperclips
Beaks (1 per student): Plastic Spoon, Eyedropper/Pipette, Chopsticks, Tweezers, Pliers
1 timer (optional)

Goal: For students to learn about how different species' beaks vary through evolution over generations of living in an area with certain available food sources.

Setup:

1. 3-5 students per station.
2. Print out the "Instructions for Students" document.
3. Cut out the bottom portion of the 'Instructions for Students' which says "Answers, do not lift until you have each taken a guess".
4. Tape the cut out over the listed answers on the 'Instructions for Students' document so students can not see them but are able to lift up the flap once they have taken a guess.
5. Place the 'Instructions for Students' printout on the table.
6. Poke or cut small holes into the plastic spoon, so water will drain through it.
7. Fill the extra cup with water & place in the center of the bowl.
8. Poor marbles, beads, bits of string, and paperclips into the bowl (around the cup) until atleast ⅓ full.
9. Leave 1 beak and 1 cup for each student.
10. Set the timer to 2 minutes.

Instructions:

1. Take a seat with the bowl between all of you
2. Take 1 beak (Plastic Spoon, Eyedropper, Chopsticks, Tweezers, Pliers) and 1 cup per student
    a. The bowl is full of simulated "food" which you will feed on using your "beak"
    b. You are each a different bird, and will each have varying diets
3. When everybody is ready. Start the timer set to two minutes.
4. "Feed" on the bowl until the timer rings, as you gather the "food" collect it into your cup
5. Once the two minutes are up, pass your cups around and see what everybody collected.

6. Take a guess. What type of bird are you?
7. Poor your food back into the bowl and the water back into the cup for the next group

Possible Answers:
Duck, Sparrow, Woodpecker, Cardinal, Jay, Hummingbird

Plastic Spoon = Duck - eating fish and worms off the water and being able to drain the water
Eyedropper = Hummingbird - eating nectar out of flowers
Chopsticks = Woodpecker - pick insects out of a tree
Tweezers = Sparrow/Cardinal/Jay - cracking seeds and picking at fruits and insects
Pliers = Sparrow/Cardinal/Jay - cracking seeds and picking at fruits and insects

Identify these Birds! – Station 2

Description:

In this activity, students will look at pictures of birds and, based on features like their feet, feathers, and beak, try to guess what the bird eats and where it lives.

Running this Activity as a Station (5 - 7 minutes)

Materials:

1. Bird pictures (provided)
2. Pens for each student
3. Journals for each student
4. One "Instructions for Students" document for the table

Setup:

Print out the pictures and answers before the lesson
Hang or lay the bird pictures out
Put the answers in an envelope for students to check at the end of the activity
3-5 students per station

Instructions for students:

1. Start by examining one picture of a bird
2. Based on some of the bird's features, hypothesize what the bird eats and where it lives/builds its nest
3. Write these answers in your journal
4. Repeat steps 1-3 for each bird
5. Discuss with your teammates why you chose your answers
6. Check the answers in the envelope and see how you did

Birds and their Feathers! – Station 3

Description:
In this activity, students will examine different types of feathers and their uses. The five feathers that the students will look at are: wing, tail, contour, semiplume, and down.

Running this Activity as a Station (5 - 10 minutes)
Materials:

1. Different Types of Feathers (Wing, Tail, Contour, Semiplume, Down), which can be obtained from the Mass Audubon, 1 of each
2. If not able to get feathers, there is a document with photos of different feathers that the students can look at and draw their hypotheses
3. Microscopes (2 or 3) (if using real feathers)
4. Pens for each student
5. One 'Feathers Worksheet' for the table (per group)
6. One 'Answer Sheet' for the table
    a. Flip this face down and write on the back, "Answer key, do not flip until finished"
7. Journals for each student

Setup:
Make sure microscope(s) are working and ready
Place 5 different feathers next to microscope
3-5 students per station

Matching Birds' Beaks and Feet! – Station 4

Description:

Students will match the different feet of birds to their heads/beaks. The students will also try to guess what the feet and beaks are used for.

Goal:

The main goal of this activity is to allow students to practice what they learned in Lesson 1 in regards to evolution by natural selection.

Running this Activity as a Station (5 - 10 minutes)

Materials:

1. 2 pairs of the Bird Feet and Birds Beaks sheet
2. Pencil

Setup:

1. Cut out the bottom portion of the 'Instructions for Students' which says "Answers, do not lift until you have each taken a guess".
2. Tape the cut out over the listed answers on the 'Instructions for Students' document so students can not see them but are able to lift up the flap once they have taken a guess.
3. Have the sheets at the station so students can get matching!

What's That Racket? – Station 5

Materials:
Computer that the students can use

Goal: Familiarize the students that there are many songs and calls used for mating, expressing territory, alarm, contact, flight and begging used by bird species.

Setup:
3-5 students per station
Open the "Instructions for Students" document on the computer

Instructions:

1. You will be listening to a variety of bird calls, and learning about the different uses birds have for making these calls.
2. Pick one student to play the audio clips without telling the rest of the group which type of call they are. The audio clips are on the second page of this document.
3. After each clip, discuss as a group which of the possible types of calls the one you just heard may be. After discussing, have the student who is playing the clips reveal the answer.

Possible Answers:
Mating Song, Territorial Call, Alarm Call, Contact Call, Flight Call, Begging Call

Mating Song: Used to attract mates
Black-capped Chickadee

Territorial Call: Usually given by a dominant bird when another chickadee intrudes on it's territory, or when arguing over food.
Black-capped Chickadee

Alarm Call: Songbirds may make high-pitched, quiet calls if there is a predator flying overhead to warn nearby birds while keeping hidden
American Robin

If the predator is perched, birds may make a louder call to rally others' and mob the predator
Black-capped Chickadee

Contact Call: To keep in touch with eachother, for example while foraging for food, birds use contact calls. These are generally short, quick, and quiet. If birds get separated they may make louder, more urgent calls.

Black-capped Chickadee

Flight Call: A flock of birds in flight will call back and forth
Brown-headed Cowbird

Begging Call:
To gain their parents' attention, young birds will make begging calls for food
Brown-headed Cowbird

Appendix J: Lesson 3

Day 3: Bird Identification Lesson Timeline

Part 1: Discussion

Ask the students, based on what they learned yesterday, how you can tell different birds apart. You could even take it a step further and ask *why* birds have these differences. Write student suggestions on the board, or have them write on the board themselves

- Beaks
    - To get different types of food
- Feet
    - To get different types of food
    - To build their nests in different places (duck vs pigeon)
- Colors
    - Camouflage
    - Mating
    - Intimidate competition
- Size
    - To get food/live in small places
- Habitat
- Behavior

Part 2: Bird ID Video

https://www.allaboutbirds.org/news/inside-birding/

Next, show them this Bird ID Youtube video, which is about 10 minutes long. The video goes over one of the most important steps to bird identification: size and shape. This video is part of a 4 episode series on bird identification. The other three videos are on color, behavior, and habitat, which are also important, but I believe the students will be able to grasp those concepts without a video. The end of the video talks about those 4 major keys to identifying birds: size and shape, color, behavior, and habitat. This is what should be introduced to the students next. After the video ends, ask the students if they remember what those four keys are and write them on the board. You may want to compare these with the student suggestions from the beginning of class.

Part 3: Introduce Field Guide

Next, introduce the field guides to the students. Each student may get their own field guide, or students can split into groups and share a field guide (group sizes may be based on the number of field guides you are able to print). There are instructions on the first page of the field guide explaining how to use it. Go over these instructions with the students, and ensure they know the purpose of the field guide. It will be useful to introduce students to the field guide before they start bird watching. This allows students to familiarize themselves with the field guide so that

when they use it outside, they can use it efficiently and spend more time actively looking for birds.

show them the Top 10 Birds powerpoint. The powerpoint shows 10 common birds in Central-Massachusetts that the students are likely to see while they birdwatch. Each slide has a picture (two pictures, if the males and females look different), as well as a description of the shape and size, behavior and habitat. This slideshow's main purpose is to familiarize the students with these birds before they go birdwatching. That way, it will be easier for students to identify these birds in the field. Another purpose of the slideshow is to familiarize the students with thinking through the steps to identify a bird. It shows them how bird watchers describe birds using the four steps to identification. Point out certain features on the bird, like beak length, feet, colors, and shape.

Part 4: 10 Bird Slideshow

Show the students the Top 10 Birds powerpoint. The powerpoint shows 10 common birds in Central-Massachusetts that the students are likely to see while they birdwatch. Each slide has a picture (two pictures, if the males and females look different), as well as a description of the shape and size, behavior and habitat. This slideshow's main purpose is to familiarize the students with these birds before they go birdwatching. That way, it will be easier for students to identify these birds in the field. Another purpose of the slideshow is to familiarize the students with thinking through the steps to identify a bird. It shows them how bird watchers describe birds using the four steps to identification. Point out certain features on the bird, like beak length, feet, colors, and shape. Encourage students to find these birds in their field guide as you step through the powerpoint.

Part 5: Bird Sketch

This can be used as an entrance or exit ticket, or as an activity in the middle of the class. Ask students to take a few minutes to draw a sketch of a bird. This sketch should encompass all four keys to bird identification, but does not necessarily have to be realistic. Encourage students to experiment with these four keys, like choosing abnormal colors or behaviors. This allows students to become more familiar with these concepts, while providing a creative outlet. You could ask students to share their drawings with the class as well.

Appendix K: Lesson 4

Day 4: Reducing Environmental Impact
Timeline and Teacher notes

At the beginning of the lesson shows the objectives and the lesson is broken up into 3 main parts

1. Reducing environmental impact when going outside
2. Ways to protect the environment
3. Prepare the students to go out and be "Ornithologists

Do Now: Have the students think of what the best part about going outside is?

Slide 4 (Introduction): Gulf Coast Oil Spill

One way to start this lesson is by describing the event of the Gulf Coast Oil Spill; this is also on slide 4 of the powerpoint.

Summary
The Gulf Coast Oil Spill occurred on April 20, 2010 when the oil drilling rig, Deepwater Horizon, operating in the Gulf of Mexico exploded and sank. Because of this, 205.8 million gallons or oil flowed into the gulf and the oil would reach the beaches of Mississippi, Alabama, and Florida. After 4 years of clean up, only about 25 percent of all the oil was recovered leaving 154 million gallons in the gulf water. Most Coast Guard clean up jobs drew to a close in 2014.

References:
https://www.epa.gov/enforcement/deepwater-horizon-bp-gulf-mexico-oil-spill
https://www.britannica.com/event/Deepwater-Horizon-oil-spill/Legal-action

Slide 5: Bird Covered in Oil

Fish and plant species were greatly harmed as well 25,90 species of marine mammals and over 82,000 birds.

References:
https://www.biologicaldiversity.org/programs/public_lands/energy/dirty_energy_development/oil_and_gas/gulf_oil_spill/a_deadly_toll.html

Slide 6: Dove Wildlife Rescue

Now this might be a depressing start to the lesson, the important part is that the Dove Wildlife Rescue went right to work and the video talks all about it. It's a short 3 minute video and it mentions the clean up effort done by those that work at Dove.
You could also mention that even though a disaster event happened, how quick we are to respond to save, not only the workers on the oil rig, but also the wildlife and the importance of protecting ecosystems.
Video: https://youtu.be/A0XvAdwFW8Q

Slide 7: How Climate Change Affects Birds
To transition into this slide, you could say that not only does disasters like the oil rig explosion affect the wildlife and birds of the ecosystem but so does climate change.

Climate change affects:

1. Habitats
   Species might lose their homes due to deforestation either by human activity or because of climate change causing long droughts.
2. Changes in Migration
   Birds follow their food like insects when migrating as well as the temperature of the ecosystem and climate change affects this by the changing temperatures.
3. Decrease Food Availability
   Some birds rely on berries and other small plants as food, so with long droughts, many plants would die leaving a limited food source for birds. Even for birds that eat insects, if there aren't plants to eat for the insects then the insects die off, and the birds that eat insects don't have any food.
4. Changes in Nesting
   If there aren't any plants or sticks around, birds will have a hard time trying to make a nest and starting a family.

References:
http://www.birdday.org/pdf/IMBD_2007_theme.pdf
https://www.borealbirds.org/threats-boreal-birds

Slide 8:
Here you can make a comment on the fact that we all can do our part in reversing the effects of climate change and try to help out our bird friends.
Then, You can have the students break into discussion groups and ask the students ways that they or their parents recycle at home then bring everyone back to have the groups discuss ways that they recycle

The next three slides go over the 3 R's of reducing carbon footprinting.

Slide 9: Reduce
Here you can mention the different ways to reduce the everyday items we use like:

- Using reusable bags instead of plastic bags at the grocery store to reduce the number of plastic bags thrown away. Also reusable bags are stylish.
- Using glass jars instead of plastic jars.
- Learn to fix up old toys instead of trying to buy new ones unless you need to. Plus it's a cool hobby and possible job

References:
https://www.huffpost.com/entry/reduce-home-waste_n_57912d0be4b0fc06ec5c4b56

Slide 10: Reuse

Here you can mention the different ways to reuse:

- Using a water bottle instead of a plastic bottle.
- Using food scraps as a compost a possible garden or plants.
- Use old egg cartons for growing plants in your bedroom or around the house.

References:
https://myheartbeets.com/reuse-13-things-normally-throw-away/

Slide 11: Recycle
Here you can mention the different ways to recycle:

- Cans, glass and plastic soda bottles, paper
- Batteries and metals
- Use rechargeable batteries, these batteries are especially for those that like to play video games so that they don't have to constantly by batteries

Slide 12: Other Ways to Help Out
This shows other examples students can do like:

- Making sure to turn off any lights in a room that is not occupied
- Walking or biking to a friend's house that is close instead of driving
- Or adding cool solar panels to their house to use renewable energy

Slide 13: What are ways to directly protect nature?
Another small group discussion, the students could either talk about other ways to protect nature or you can bring up state parks and ask them about their favorite state park and memory.

A way to transition into this section to say something about how groups and organizations work together to protect natural areas from human interference.

Slide 14: Yellowstone and Purgatory Chasm
Here can talk about two popular examples, Yellowstone and Purgatory Chasm.

Yellowstone:
Yellowstone National Park is the first national park established in the United States.
Established by Congress as a national park on March 1, 1872, the area protects all the plants and animals of the area from human settlement and deforestation.
This also was the start of making natural areas national parks to protect the diverse ecosystem that makes up the United States.

Purgatory Chasm:
One that's a little closer is Purgatory Chasm State Reservation in Sutton, Massachusetts.
Named a state park in 1919, it also serves to protect the natural beauty of the area as well as the ecosystem and its inhabitants.

References:
https://www.nps.gov/yell/learn/historyculture/yellowstoneestablishment.htm

https://www.atlasobscura.com/places/purgatory-chasm-2

Slide 15: MassAudubon
Here you can talk about the MassAudubon located all throughout Massachusetts. The people that work there dedicate their lives to protecting the nature of Massachusetts.

The MassAudubon is also a program dedicated to protecting nature and more specifically the birds that inhabit Massachusetts.
The program was founded by two women named Harriet Lawrence Hemenway and Minna B. Hall in 1896.
The program's mission is to protect the nature of Massachusetts for people and for wildlife.
Today the MassAudubon protects over 38,000 acres of wildlife habitat across the state.
They are also one of the largest statewide providers of environmental education programs for all ages by running week long events and camps.

References:
https://www.massaudubon.org/

Slide 16: Transition Slide
The slide transitions into the section on ornithology.
You can ask the students if they have heard of the term ornithology or know what an ornithologist does.

Slide 17: What is an Ornithologist?
Here you can go into further detail about ornithology and what ornithologists do

An Ornithology is the study of birds and an ornithologist dedicated their life to studying all about them. This includes studying their behavior, physiology, and conservation of birds and their habitats. Ornithologists conduct maily field research to further understand migration and habitat needs.

You can also talk about the Cornell Lab of Ornithology which is the lead institution in ornithology and have studied birds all around the world. They have also created bird identification apps like Merlin Bird ID which helps those identify the birds they see.

References:
https://www.environmentalscience.org/career/ornithologist

Slide 18: Outdoor Class Preparation
Here you can prepare the students for going outside the next day.
This slide also includes the do’s and don’ts when studying birds

Slide 19: Remember their checklist and field guide!

Slide 20: Exit Ticket

1. Here you ask students to list five birds that they might see on the day they go outside, or
2. They can write down on a piece of paper how they plan on using the 3 R's at home; reducing, reusing, recycling, or
3. They can say what they are most excited about tomorrow's lesson in which they get to be ornithologists.

Appendix L: Lesson 5

Preparation:

- Ensure you are prepared to bring the students outdoors
    - Check in with the nurse regarding your students
    - Epi-Pens and other allergy necessities
    - Radio/Phone for emergencies
    - Execute your schools procedures for an outdoor lesson (e.g. Let the administration know when you will be outside)

Beginning of class:

- Make sure each student has a checklist, and that you have a checklist and field guide. We also recommend that you download the Merlin Bird ID app by the Cornell Lab of Ornithology to use while birdwatching with the students.
- Split students into groups of 3 and 4, and provide each group with a field guide. (group size can be altered based on number of field guides printed)
- **Optional:** Tell the students they are being graded out of 20 points on the outdoor activity
    - This will remind them that this is still class time and not recess.
    - You may evaluate the students during the outdoor activity, and optionally ask them for a self evaluation at the end of class.
    - The rubric is included in the day 5 folder "outdoor-rubric.docx"

Opener:

- Remind the students that they are ornithologists for the day.
    - The students are being graded on their behavior outdoors
- Have the students discuss with their group any bird species from their checklists they already know about.
- Before going outside, remind the students of any general safety precautions your school expresses.

Learning Activity:

- Bring the class outside into the schoolyard, parking lot, field, or trails.
    - Remind the students to be quiet as possible. During the day birds are less active and can be easily disturbed.
- Bring the group together and use the pishing technique to attract small songbirds.
    - The 'Pshh Pshh Pshh' sound mimics the sound small birds use to warn each other of injury or when a bird of prey is sighted in the area.
    - The most common going theory is that this sound will cause small birds to come to the edge of cover in order to locate the cause of alarm
    - https://www.youtube.com/watch?v=34E2EsVkDqg
    - https://www.youtube.com/watch?v=Eba0M9AOgRo
- Working in their groups, ask the students to stay within your preferred vicinity and begin to birdwatch
- They should be checking off species from their checklist as they find them.

Summary/Closing

- Return to the classroom
- ask the following questions, have them write the answers on a slip of paper if you normally do exit tickets:
    - Did you learn any new bird species?
    - Did you see more birds than you expected?
- **Optional:** Hand out the rubric for self evaluation, or just evaluate the students on your own.

Appendix M: Outdoor Rubric

Name: My Total: _____/20_____
Date: Teacher's Total: _____/20_____
Block:

Outdoor Classroom Rubric

Skill	4	3	2	1
Following Directions	I followed all of the directions for the activity.	I followed most of the directions.	I needed a reminder about directions.	I needed many reminders about directions.
Safety	I followed all safety instructions.	I followed most safety instructions.	I needed a reminder to stay safe.	I needed many reminders about the safety behaviors.
Activity	I worked very hard on the activity.	I did pretty well on the activity.	I need to work harder on the activity.	I had a lot of difficulty with the activity because I wasn't trying.
Listening	I stopped and listened every time it was signaled.	I stopped and listened most times it was signaled.	The teacher had to remind me to stop and listen when it was time.	I needed many reminders to stop and listen.
Focus	I stayed on task throughout the entire activity.	I needed a reminder to stay on task.	I needed many reminders to stay on task.	I probably need to stay inside during the next activity.

Additional Comments or Discussion: