

Earth Day Concerns and Social Studies

mll
middle level learning

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Head Injuries: Birds, Glass, and a Major League Stadium

Steven Sellers Lapham

below: Photo of birds collected after colliding with buildings, Toronto 2009, by Kenneth Herdy, FLAP



The problem of brain damage resulting from collisions between football players has gotten a lot of media attention in recent years, especially when the players are school children.¹ But other species are also at risk from this sport. Birds will also suffer head injuries from colliding with the glass facade of the new Minnesota Vikings football stadium, nearing completion in Minneapolis. The building's 200,000 square feet of glass will let in natural light and allow the game to go on despite bad weather. But biologists expect that this "shiny cathedral for football" (the venue slated for the 2018 Super Bowl) will be deadly for birds, as it is located on the Mississippi Flyway (a major migratory route for songbirds and waterfowl in the United States) and contains so much glass.²

Birds often fly into clear and reflective glass. Instead of a window, birds perceive a clear path forward (due to transparency) or they perceive clouds or trees (due to reflection). The problem is understandable; even humans sometimes bump into glass doors. (**Handout A: Why Glass is a Triple Threat, p. 6**) After a collision, birds often die from internal bleeding, are unable to survive day-to-day challenges (e.g., avoid a predator) or cannot continue a migration and perish.

A Topic for Earth Day's 45th Anniversary

Earth Day is celebrated each year on April 22, and 2015 will be the 45th anniversary of that event.³ Teachers are often looking for an Earth Day topic that students can discuss, read about, write about, take action on, and relate to subjects that they are learning. Understanding the controversy over the new Vikings stadium—and studying the problem of birds striking windows in your own neighborhood—involves nearly every subject, including math, science, language arts, as well as art and architecture. The four main areas of social studies—*history, civics and government, geography, and economics*—are central to understanding and solving the problem of bird strikes, locally and globally. The remainder of this article is organized under those four headings. Specific activities for students, and ways in which they might engage this topic, are suggested in the handouts, especially **Handout B: Build a Bird Saver, p. 7**.

ON THE COVER: Students from Gaithersburg Middle School (MD) hold up a handmade Acopian Bird Saver, designed to prevent bird strikes on a window. Bird models courtesy of Wild Bird Center of Rockville (MD). See also page 7.

The IKMZ Library, a bird-friendly building, in Cottbus, Germany. Herzog and de Meuron Architects.



Geography

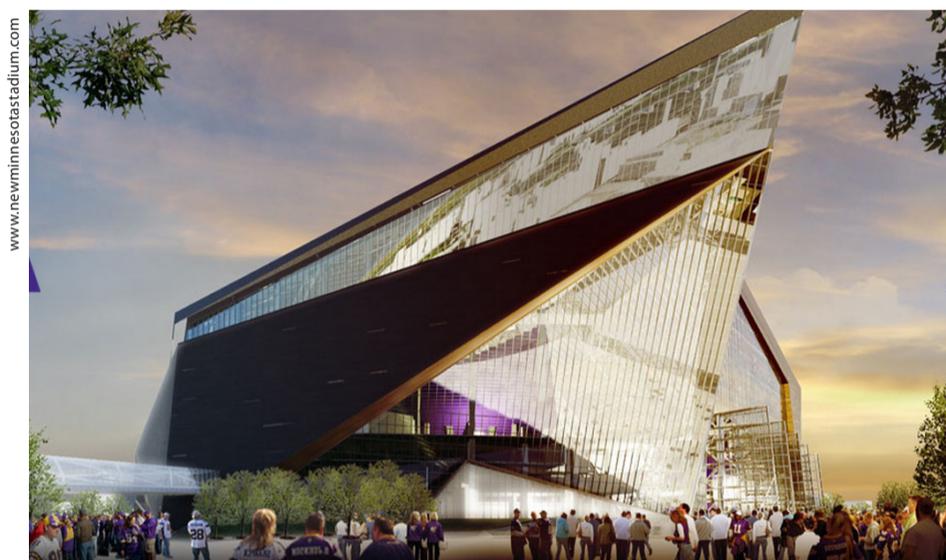
The tiny Cerulean warbler, singing at your window in the spring, has just finished a 2,000-mile flight from its winter home—in Peru (It’s a species threatened with extinction.) Forty percent of all North American waterfowl, and up to 50 percent of all migratory bird species use the Mississippi River as a navigational aid. So many birds follow the Mississippi Flyway that they are picked up by radar on calm evenings. Since most song birds migrate at night, any count is an estimate, but it’s probably safe to say at least 1 billion birds use this airborne path each year. **(Handout C: American Flyway Map, p. 8)**

The Minnesota Sports Facility Authority (MSFA) has chosen to build its new stadium on a spot that North America’s migratory birds pass over during spring and fall migration. That might be of little consequence to birds—if the stadium were not shrouded with glass.

Economics

Wild birds are no longer a major source of food for most North Americans, but wild passenger pigeons fed the pioneers as they moved westward. With a likely population between 3 and 5 billion, the passenger pigeon was the most abundant bird in North America and probably the world. Yet human exploitation drove this species to extinction over the course of a few decades. The year 2014 marked the 100th anniversary of that species extinction. (See free K-12 lessons at Project Passenger Pigeon, passengerpigeon.org).

If we think of birds as a “natural resource,” then there are many benefits to having them around. It’s difficult to estimate the “dollar value” of bird watching, but a 2011 report estimated that 47 million U.S. birders spent \$41 billion on their recreation that year, supporting 660,000 jobs through their behavior (e.g.,



Vikings Stadium model, plaza perspective.

buying equipment; traveling to parks).⁴ The value of waterfowl as a recreational resource for licensed hunters is even greater.⁵ Even if we are not aware of it, birds benefit humans in their role as natural pest-control agents. For example, one barn swallow may eat 850 insects per day.⁶ It’s hard to estimate the benefits to agriculture and sheer livability (think of mosquitoes and flies) that birds provide, but scientists are predicting that the loss of bird species (6 to 14 percent of all species by 2100) will have harmful effects to ecosystem processes and agricultural production.⁷

Turning now to the details of the Vikings stadium, its construction will cost more than \$1 billion, half of which is public money. What would it cost to make the stadium safer for birds? Using a product called fritted glass would have added about \$1.1 million to the cost of the stadium. Fritted glass was initially developed for energy conservation, because it reduces solar glare and heat. Birds see the pattern and avoid flying into it. Thus, for less than 0.1 percent of the total stadium budget, MSFA could reduce bird deaths and benefit in other ways, such as curbing the negative publicity that seems to be amplifying.

(Handout D: Innovations to Prevent Bird Collisions, p. 9) Civics and Government

It seems odd that MSFA did not respond to early warnings, during planning and public discussion, about the bird strike problem. Professor Daniel Klem, one of the pioneers of research on bird strikes and their prevention, stated, “You’re building a bird killer.”⁸ MSFA has made an effort to follow voluntary best practices for “green buildings,” but seems to have overlooked guidelines (to prevent bird strikes) that were recently added to that document.⁹

One side of the Dallas Cowboys Stadium (designed by the Vikings’ architect) was built using fritted glass for reasons of bird safety and energy conservation. Hundreds of buildings around North America use fritted glass, including zoos and museums. Nevertheless, in July 2014, MSFA announced that it would not make any changes to the glass walls of the stadium to protect birds. (But see update below!)

It’s clear from surveys of bird fatalities at the base of glass buildings in our major cities that “free market forces” alone have not created incentives to prevent massive bird fatalities.¹⁰ Reducing bird strikes will also require education through the media, volunteer advocacy and action, discussion and debate, and probably new legislation.

In Minnesota, despite public petitions, requests from mul-

iple prominent bird conservation organizations, and a unanimous resolution from the Minneapolis City Council, the MSFA has strongly resisted using technologies that could save the birds. What other options might citizens have for tackling and solving this problem? Are there other actors in government, business, and civic life that could be called into play? (**Handout E: Birds Rely on the “Three Branches” and “Grass Roots,” p. 10**) Maybe U.S. history can offer some suggestions.

Culture and History

Birds certainly provide people with the pleasure of their songs, colors, and flight across the sky. “Some of our most enduring cultural symbols are birds, reflecting the many qualities that human beings admire in them and aspire to in themselves.”¹¹ Consider, for example, how humans have used the eagle, hummingbird, dove, sea hawk, sparrow, falcon, and pelican in symbols and icons.

If we do care about preserving birds, how can we do that? What examples from history reveal how social change can begin? Consider the examples on a timeline, **Handout F: Saving Birds Over the Decades, p. 11**. Let’s also consider three examples here. In 1903, founder of the Sierra Club John Muir led President Theodore Roosevelt on a camping trip in Yosemite, and the idea of national parks was born.¹² In 1960, biologist Rachael Carson published *Silent Spring* (about the dangers of DDT to birds and humans alike), and the modern environmental movement took wing.¹³ The idea for Earth Day came to founder Gaylord Nelson, then a U.S. Senator from Wisconsin, after witnessing the ravages of a massive oil spill in Santa Barbara, California, in 1969. Inspired by the student anti-war movement, Senator Nelson announced the idea for a “national teach-in on the environment” to the national media and persuaded Pete McCloskey, a conservation-minded Republican Congressman, to serve as his co-chair.¹⁴

From these three examples, we can hypothesize that it takes both volunteers and professionals to begin a campaign for environmental reform. If we examine the effects of the reforms that followed, we might conclude that just about everybody benefits from well-crafted legislation. Human beings, not just wildlife, are now healthier because of the Clean Air Act (1963) and Water Quality Act (1965). Today, industries find it easier to plan and operate their facilities when the rules are clear and there are incentives for reducing and recycling waste products—and for developing clean alternatives to processes that pollute.¹⁵

UPDATES!

As we prepare to post this issue of *MLL*, there are two items of late-breaking news about stadium construction.

.....
Tim Nelson, “Lawmakers Look to 3M to Make Stadium Bird-Safe, but Solution Not Clear” (MPR News, December 10, 2014), www.mprnews.org.

.....
Michele Kelm-Helgen, chair of the Minnesota Sports Facilities Authority (MSFA), made this statement to the media on December 10, 2014:

“We have continued working with various groups to address their concerns regarding potential bird collisions. Most recently, the MSFA, 3M [corporation], the Audubon Society [of Minnesota], and the Vikings had preliminary discussions regarding the testing of possible 3M bird-safe window film solutions. We are continuing to work with this group to explore the possibility of a study that would occur during bird migratory seasons in various locations in Minnesota. The proposed plan would be to include the stadium in the study once it is built. These initial conversations have been positive and productive, and we are hopeful that we will have more information to share in the near future.”

How do technical innovations “get traction” in our busy civilization? Today, there are numerous technologies already available for reducing and preventing bird strikes on glass. A short *National Geographic* video shows how the testing of new bird-repel materials is done.¹⁶ Some exciting and growing for-profit enterprises are marketing these technologies in this country and around the world, reducing bird fatalities and creating jobs for people. (See four examples listed on Handout D).

What Can We Do?

Students can read about the problem, contact MSFA,¹⁷ and contact one or more organizations working on solutions. The Audubon Society is now focusing on trying to get Minnesota Governor Mark Dayton to intervene and ask the MSFA board, half of which was appointed by the governor, to change course. As of this writing, students can, if they wish, go online to sign the petition.¹⁸ Other nonprofit organizations are working to prevent bird collisions, notably the American Bird Conservancy (or ABC, in the United States) and the Fatal Light Awareness Program (or FLAP, in Canada).¹⁹

In any community, students can pay attention to which windows on nearby buildings appear to be a hazard for birds, and talk with building owners about preventative technologies. If birds are colliding with a window at home, students can build and hang an Acopian bird saver or consider using ABC Birdtape. (See Handouts B and D, and the cover photo). The first step is to learn about the problem and discuss it with others who are concerned, and then foster a dialog with those who could be part of the solution.²⁰ If a tiny Cerulean warbler can navigate a 2,000-mile journey, maybe humans can “design an end run” around glass windows for the birds. 🌐

Notes

1. To access a collection of articles about concussions and sports, search on “head injuries in football” at topics.nytimes.com.
2. Gwen Pearson, “Have the Vikings Built a Thunderdome for Migratory Birds?” (www.wired.com, September 4, 2014). Pearson, whose article is the main source for this MLL article, is Network Coordinator for the Organization of Biological Field Stations. Pearson runs Get Your Nature Geek On, a small company focused on science communication and websites for nature and research centers. The article is at <http://www.wired.com/2014/09/the-new-minnesota-vikings-stadium-will-kill-migratory-birds>. A background booklet on preventing bird collisions is at www.abcbirds.org/abcprograms/policy/collisions/pdf/Bird-friendly_Building_Guide_WEB.pdf.
3. Read about the Green Schools Campaign at www.earthday.org/edu-network and EarthDay history at www.earthday.org/earth-day-history-movement.
4. U.S. Fish and Wildlife Service (USFWS), “Birding in the United States” (2001): p. 14, nctc.fws.gov/resources/knowledge-resources/surveys/birding01.pdf.
5. USFWS, “Economic Impact of Waterfowl Hunting in the United States” (2016), digitalmedia. fws.gov/cdm/ref/collection/document/id/1152
6. “Barn Swallow: Natural Pest Control,” birdnote.org/show/barn-swallow-natural-pest-control.
7. C. H. Sekercioglu et al., “Ecosystem Consequences of Bird Decline,” *PNAS* 101, no. 52 (2004), www.pnas.org/content/101/52/18042.full.
8. Klem quoted in G. Pearson, 2014.
9. MSFA points to seven design elements that will help prevent “light spillage” from the stadium. Artificial lighting can disorient birds migrating at night. Read more about birds and light at American Bird Conservancy, “Bird-friendly Building Design,” collisions.abcbirds.org/design.html. The acronym LEED stands for Leadership in Energy Efficiency and Design.
10. Karen Houppert, “‘Lights Out’ Seeks to Stem Bird Casualties Caused by City Skylines,” *Washington Post Magazine* (March 13, 2014). Enter the title, and see the slide show at www.washingtonpost.com/lifestyle/magazine.
11. BirdLife International, www.birdlife.org/datazone/sowb/introduction/INTRO4. This website also states that globally, it’s estimated that “nearly half of all bird species are used directly by people,” www.birdlife.org/datazone/sowb/casestudy/98.
12. Carol Thornton, “Theodore Roosevelt, John Muir, and the Idea of National Parks,” *Middle Level Learning* 50 (May/June 2014): 16-18, www.socialstudies.org/archives.
13. Caroline C. Sheffield and Ingrid S. Weiland, “Ducks Ahoy! Bath Toys, Marine Debris, Geography,” *Middle Level Learning* 46 (September 2012): 16-18, www.socialstudies.org/archives.
14. Read about EarthDay’s history and impact at www.earthday.org/earth-day-history-movement.
15. National Park Service, “Lyndon B. Johnson and the Environment” (www.nps.gov/lyjo/planyourvisit/upload/environmentcs2.pdf)
16. Jane J. Lee, “How Better Glass Can Save Hundreds of Millions of Birds a Year,” *National Geographic* (November 13, 2014), news.nationalgeographic.com/news/2014/11/141113-bird-safe-glass-window-collision-animals-science.
17. This team webpage www.vikings.com/stadium/new-stadium has descriptions and images of the stadium. This FAQ webpage www.newminnesotastadium.com/faq did not mention birds (on 12/11/2014), but stated, “the glass and glazed curtain walls on the stadium’s exterior is being manufactured by a Minnesota-based company...Glass installation is scheduled to begin as early as January 2015.” See the MSFA statement in the sidebar on page 4.
18. The Audubon Society of Minnesota, mn.audubon.org/change-glass-save-birds. Joanna Eckles, Bird-friendly Communities Manager, Audubon (Minnesota), can be reached at jeckles@audubon.org.
19. American Bird Conservancy, www.abcbirds.org; Christine Sheppard, ABC’s Campaign Director for Bird Collisions, can be reached at csheppard@abcbirds.org; Another online resource is Fatal Light Awareness Program, www.flap.org.
20. A citizen-science project, managed by Stephen B. Hager (Augustana College, Rock Island Illinois) in collaboration with EREN (Ecological Research as Education Network), can be found at “Bird-window Collisions across North America,” sites.google.com/a/augustana.edu/eren-bird-window-collisions-project.

STEVEN SELLERS LAPHAM is editor of Middle Level Learning

Why Glass is a Triple Threat to Birds



Composite photo of birds killed at buildings in Baltimore, by Daniel Lebbin, ABC

Birds have evolved over millions of years in response to threats in their environment. But humans have invented new dangers at a very rapid pace. Many species are threatened because of human activities. If we destroy a habitat, birds can't hide from predators, build nests, or find food. If we use insecticides, birds cannot find enough bugs to eat, or they may die from chemical poisoning.

Window glass poses a triple threat to birds.

- 1) **Transparency:** Birds cannot see the glass that is in their flight path. It is invisible to them.
- 2) **Reflection:** If the sunlight is just right, birds see images of leaves or clouds, not glass.
- 3) **Light:** Artificial light can confuse birds, and it might lead them into a windowpane.

Birds do not think like we do. Birds do not perceive a rectangular aluminum shape to be a "window frame." They see through the glass

or reflections on its surface. Even humans sometimes walk into glass doors, so we know that clear glass can be hazardous.

How do you know when a bird has hit a window? **Evidence** can include a dead bird on the ground, or bits of skin and feathers on the glass. The smudge will look like a little patch of snake skin. Often, a scavenger (like a cat) will carry away a dead bird, so there may be little or no evidence of the bird strike. If you find a dead bird, take a picture of it, but do not pick it up, as birds sometimes carry germs that are harmful to humans. Tell an adult about it, and discuss what you know about the causes and prevention of bird collisions with glass.

The **American Bird Conservancy's** campaign to protect birds from collisions, works with industry representatives, the federal government, and other conservation groups to find solutions to this growing problem. Visit their webpage "Birds and Collisions" at www.abcbirds.org/abcprograms/policy/collisions/index.html and also collisions.abcbirds.org.

Build a Bird Saver

If you are concerned about birds hitting a window, here are some things you can do.

1) Closing the blinds (when you don't need to see through a window) helps in two ways. It ends the problem of transparency, as birds are not tempted to fly through the glass. It can also reduce reflections somewhat, as fabric behind the glass can dull the reflection. Closing the shades is not a perfect solution, but it can help.

2) Talk to the building manager about retrofits, if birds are hitting the window. (See Handout D for examples of film that can be placed on glass to repel birds). ABC Bird Tape, for example, is easy to use.

3) Build an Acopian bird saver and put it up at your home. They are inexpensive and easy to make. Put them on the outside of the window. Birds flying towards the window will see the cords, avoid them, and not fly into the glass.

- A) Use $\frac{1}{8}$ inch diameter, dark colored, paracord (parachute cord), which you can find in a military surplus or camping store.
- B) Attach the paracord on the outside of the window, above the glass, hanging down vertically.
- C) Space the strands of paracord 3.5 to 4 inches apart from each other.
- D) If you are concerned about wind blowing the cords, the bottoms of the cords can be attached below the glass, although many people like the effect when the cords stop about 2 inches above the bottom of the glass.

Learn more about **Acopian Bird Savers**, and see various examples of its use, at www.birdsavers.com/buildyourown.html

Learn about the **scientific testing of materials** to repel birds from windows. This National Geographic video is about 3 minutes long: news.nationalgeographic.com/news/2014/11/141113-bird-safe-glass-window-collision-animals-science



American Flyway Maps

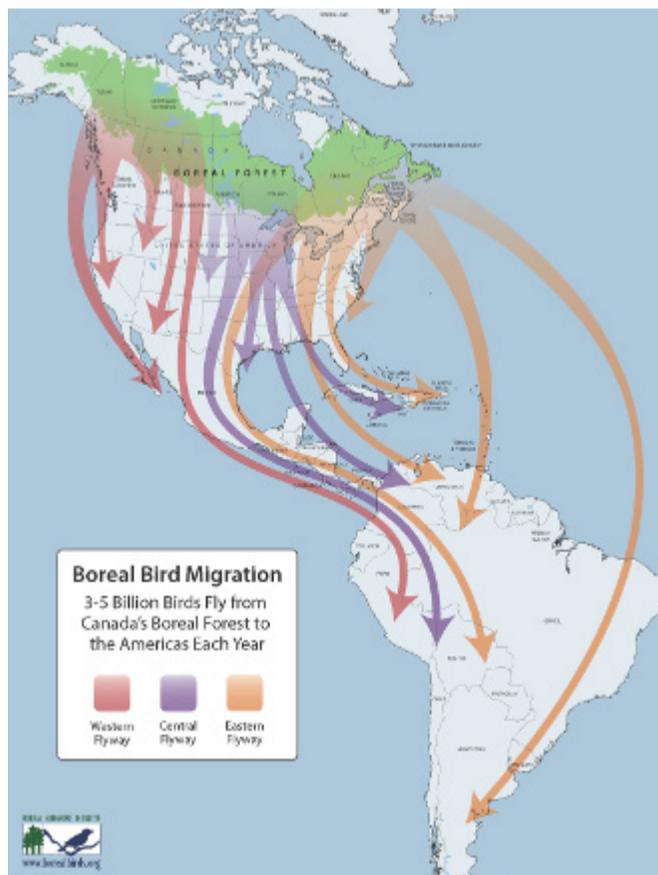
Waterfowl Flyways Over North America

North Dakota Game and Fish Department



Source: www.fws.gov/refuges/refugeupdate/MarApr_2012/fourflyways.html

Boreal Flyways Map

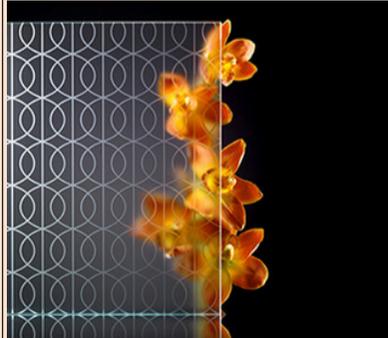


Source: www.borealbirds.org/publications/boreal-flyways-map

Innovations to Prevent Bird Collisions

Which product would you use at your home? At your school? What test was used to show that the product really works? It is okay to write “CANNOT FIND” if the website does not tell you how a product was tested. (See Handout B for a low-tech, do-it-yourself bird saver.)

See bird-repel products being tested in this short video: Jane J. Lee, “How Better Glass Can Save Hundreds of Millions of Birds a Year,” *National Geographic* (November 13, 2014), news.nationalgeographic.com/news/2014/11/141113-bird-safe-glass-window-collision-animals-science. 

Product Company Name, Location Website	Description	Test of Effectiveness	Illustration
CollidEscape Bierte, Inc. Janesville, Wisconsin www.collidescape.org	TOTAL-COVERAGE FILM. CollidEscape is a film that “makes your windows visible to birds without obstructing your view of the great outdoors.” It is similar to the film used for advertisements on fast food restaurant and bus windows—colorful from the outside, but see-through from the inside.		
ABC Bird Tape American Bird Conservancy The Plains, Virginia www.abcbirdtape.org	STRIPS OF FILM. Translucent, “easily applied and removed, this tape lasts up to four years on an outside surface.” Each roll treats up to five 24 × 32 inch windows. Place vertical strips 4 inches apart on the window.		
AviProtek Walker Textures Montreal, QC, Canada walkerglass.com/products/bird-friendly-glass	PATTERNED GLASS. “Patterns etched on the outside surface of the glass” meet the 2 × 4 inch Rule. It’s effective “both from a direct or angled view.” (See also Goldray Glass of Calgary, Canada, goldrayglass.wordpress.com/2013/09/11/1st-surface-ceramic-frit)		
Ornilux Glass ArnoldGlass Hamburg, Germany www.ornilux.com/bird-glass.html	GLASS THAT LOOKS CLEAR to humans, but birds see a pattern in UV (ultraviolet) light. The glass provides “natural light” for people inside. The technology is based on a chemical in spider webs that catch bugs, but repel birds. (See also www.ornilux.com/attachments/Case_Study_Ornilux_MASTER.pdf)		

Birds Rely on the “Three Branches” and “Grass Roots”

How have the three branches of government helped birds?* Here are some examples of federal action (by the national government). Each state also has laws, agencies, and court rulings that affect the well being of birds. Can you find your state agencies listed at this website? www2.epa.gov/home/health-and-environmental-agencies-us-states-and-territories.

The Migratory Bird Treaty Act of 1918 is the primary law protecting native birds in the United States. It's one of this country's earliest environmental laws. It prohibits killing a wild bird or possessing all or parts of a wild bird, including feathers, nests, or eggs. Exceptions are allowed for hunting game birds and for research purposes, both of which require permits. (www.dnr.state.md.us/wildlife/Plants_Wildlife/MBirdTreatyAct.asp)

President Dwight Eisenhower established the Arctic National Wildlife Refuge in 1960. It's the summer home for more than 160 species of birds (policy.audubon.org/arctic-national-wildlife-refuge). Federal agencies responsible for the health of birds and their habitats include:

- Environmental Protection Agency (EPA)
- National Park Service (NPS)
- National Oceanographic and Atmospheric Administration (NOAA)
- National Forest Service (NFS)
- Fish and Wildlife Service (FWS)



In 2011, the U.S. Supreme Court denied a petition by pesticide manufacturers who wanted to end the EPA's ban of the pesticide carbofuran, which goes by the trade name of Furadan. News reports have stated that Furadan has sickened farm workers and killed millions of birds. A single grain can kill a bird. (www.burdr.com/2011/06/supreme-court-backs-ban-on-pesticide/. Company viewpoint at phx.corporate-ir.net/phoenix.zhtml?c=117919&p=irol-newsArticle&ID=1569079&highlight)

Legislative

Executive

Judicial

Birds also rely on **individuals** and **citizen organizations** to work on their behalf. These actors could be depicted as the “grass roots” and “seeds” of good governance.

American Bird Conservancy
Audubon Society
Sierra Club

Girl Scouts
Boy Scouts
Cornell Lab of Ornithology

The Nature Conservancy
Partners in Flight
4-H Programs

* A teaching idea shared by E. Brown and L. Silvestri, “Grassroots Activists and the Three Branches of Government: Key Players in the Civil Rights Movement,” *Social Studies and the Young Learner* 27, no.1 (September/October 2014): 13–18.

Saving Birds Over the Decades

Read all the entries, then chose one of these topics, and learn more about it at the listed URL.

- 1900** The first Annual Christmas Bird Count—instead of a Christmas Bird Hunt—is held. It’s an early example of “citizen science.” birds.audubon.org/christmas-bird-count
- 1903** President T. Roosevelt creates the first National Wildlife Refuge, Pelican Island, Florida, to protect water birds from plume hunting. (People want bird feathers for fashionable hats). www.fws.gov/pelicanisland/history.html
- 1914** Martha, the last living passenger pigeon, dies in a Cincinnati Zoo. passengerpigeon.org
- 1918** Migratory Bird Treaty Act ratified by U.S. Congress. www.dnr.state.md.us/wildlife/Plants_Wildlife/MBirdTreatyAct.asp
- 1934** Roger Tory Peterson’s first *Field Guide to the Birds* is published. www.houghtonmifflinbooks.com/peterson
- 1940** Bald and Golden Eagle Protection Act passed by U.S. Congress. www.fws.gov/midwest/midwestbird/eaglepermits/bagepa.html
- 1962** Rachel Carson’s *Silent Spring* is published. Search on “Rachel Carson” at www.pbs.org/moyers/journal
- 1970** The first Earth Day is celebrated, with teach-ins at schools and campuses. www.earthday.org/about-earth-day-network
- 1973** The Endangered Species Act is passed by U.S. Congress. www.epa.gov/espp
- 1992** California Condor reintroduced into the wild successfully. National Park Service, www.nps.gov/grca/naturescience/condor-re-introduction.htm
- 1994** EPA down-lists the bald eagle from endangered to threatened. The national bird appears to be recovering. www.fws.gov/Midwest/eagle/index.html
- 2002** Online “citizen science” is boosted by eBird.org, the world’s biggest database of biodiversity. It creates “a real-time monitor of global habitat health.” ebird.org/content/ebird/about. See also www.allaboutbirds.org



http://commons.wikimedia.org/wiki/File:American_Kestrel_3.jpg

MAIN SOURCES: Timeline of Audubon Society Accomplishments, www.audubon.org/timeline-accomplishments; Robert Brown, “A Conservation Timeline,” www.azgfd.gov/pdfs/hahwg/TWS-articles/A%20Conservation%20Timeline-4pg.pdf; A Timeline of Ocean Conservation, *Middle Level Learning* (46 (January/February 2013)), www.socialstudies.org/publications/archives.

From Mountains, to Prairies, to Ocean Shores:

U.S. National Landmarks at Risk

Union of Concerned Scientists

The growing consequences of climate change are putting many of the United States' most iconic and historic sites at risk. From Ellis Island to the Everglades, and Cape Canaveral to California's César Chávez National Monument, these sites symbolize values that unite all Americans' patriotism, freedom, democracy, and more—and together help weave the very fabric of our shared history. Today these sites face a perilous and uncertain future in a world of rising sea levels, more frequent wildfires, increased flooding, and other damaging effects of climate change.

We must prepare our cherished landmarks for these worsening climate impacts and take steps to make climate resilience a national priority. At the same time, we must work to minimize these risks in the future by reducing the carbon emissions that are causing climate change and its accompanying impacts.



Examples of the Problem

Our 2014 report, “National Landmarks at Risk: How Rising Seas, Floods, and Wildfires Are Threatening the United States' Most Cherished Historic Sites” highlights 30 at-risk locations (in 15 states) chosen because the science behind the risks they face is robust, and because

together they shine a spotlight on the different kinds of climate impacts already affecting the United States' cultural heritage.¹ **(HANDOUTS 1 & 2)**

At some sites—such as Liberty and Ellis Islands and Cape Hatteras—steps have already been taken to prepare for these growing climate risks. At many other sites, such efforts have not yet begun. All the case studies draw on observations of impacts that are consistent with, or attributable to, human-

induced climate change based on multiple lines of scientific evidence.

A Call to Action

As these case studies illustrate, climate change is no longer a distant threat for others to worry about. The consequences are already underway, with serious and growing risks to the places and communities we care about.² If future generations of Americans are to experience the joy and wonder that these extraordinary places engender, we must act now to protect them from the impacts of climate change today and prepare for expected additional changes tomorrow. **(HANDOUT 3)**³

We must also take steps to minimize the risks of climate change in the future by taking immediate action to reduce the carbon emissions that are driving up the Earth's atmospheric temperature. The historic legacy of the United States is at stake.⁴

Notes

1. The report is posted at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/National-Landmarks-at-Risk-Full-Report.pdf.
2. National Park Service, “Global Warming: Is It Real? How Will It Affect Us? What Can We Do About It?” A one-page brochure at http://www.nps.gov/training/tel/Guides/climate_change_brochure2_08072008.pdf.
3. NCSS editors composed the handouts, using some material from the UCS report in Note 1.
4. Many other nations are also experiencing harmful effects from global warming, trying to plan for the future changes, and seeking ways to lower their carbon input into the atmosphere. NASA (climatekids.nasa.gov), the EPA (www.epa.gov/climatestudents), and the Environmental Defense Fund (www.edf.org/climate) all have kid-friendly webpages on this global challenge. 🌍

ABOUT THE AUTHOR: *The Union of Concerned Scientists has combined the knowledge and influence of the scientific community with the passion of concerned citizens to build a healthy planet and a safer world. UCS, which has its headquarters in Cambridge, Massachusetts, has worked for nearly 50 years on issues such as clean energy, clean vehicles, food and agriculture, global warming, nuclear power, and nuclear weapons. Visit www.ucsusa.org. Teachers might also wish to visit the Center for Science and Democracy at www.ucsusa.org/our-work/center-science-and-democracy, which reports on the role of science and public policy in issues of national concern.*

National Landmarks at Risk Due to Climate Change

(Examples from 15 States)

Alaska: Cape Krusenstern National Monument and Kivalina; Bering Land Bridge National Monument and Shishmaref

California: Groveland César E. Chávez National Monument; NASA Ames Research Center

Colorado: Mesa Verde National Park

Florida: Castillo de San Marcos; Fort Mose; St. Augustine's historic downtown; NASA Kennedy Space Center in Cape Canaveral

Hawaii: Kaloko-Honokohau and Pu'uhonua o Honaunau National Historic Parks

Louisiana: NASA Michoud Assembly Facility

Maryland: Harriet Tubman Underground Railroad National Monument

Massachusetts: Boston's Faneuil Hall and the Blackstone Block Historic District

Mississippi: NASA Stennis Space Center

New Mexico: Bandelier National Monument and Santa Clara Pueblo

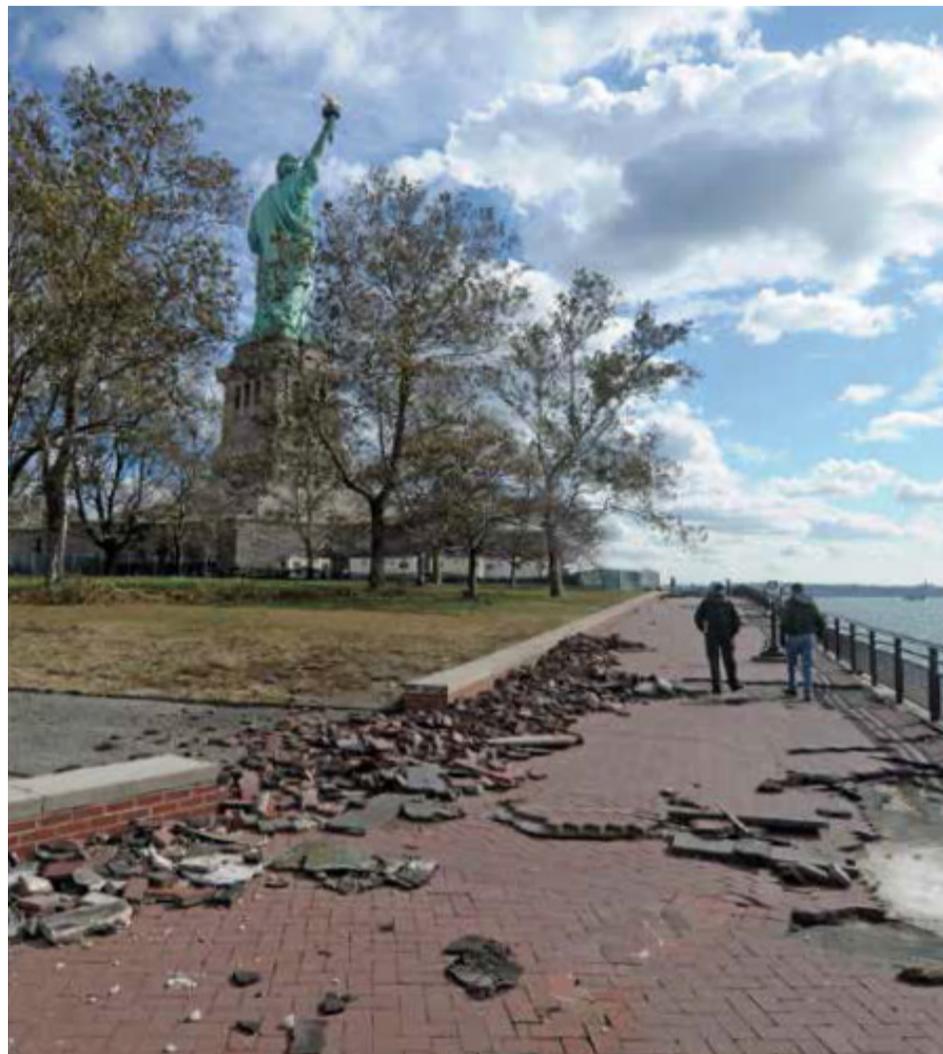
New York: Statue of Liberty and Ellis Island

North Carolina: Cape Hatteras Lighthouse

South Carolina: Charleston's Historic District

Texas: Johnson Space Center

Virginia: Historic Jamestown; Fort Monroe National Monument; NASA Wallops Flight Facility and Langley Research Center 🌐



In 2012, Hurricane Sandy's storm surge damaged Liberty Island, closing it for eight months. Detail from "National Landmarks at Risk" (NPS/Daly).

Research Your Topic by Visiting these Websites

Learn in detail about each of these places in the report "[National Landmarks at Risk](#)" by the Union of Concerned Scientists (www.ucsusa.org).

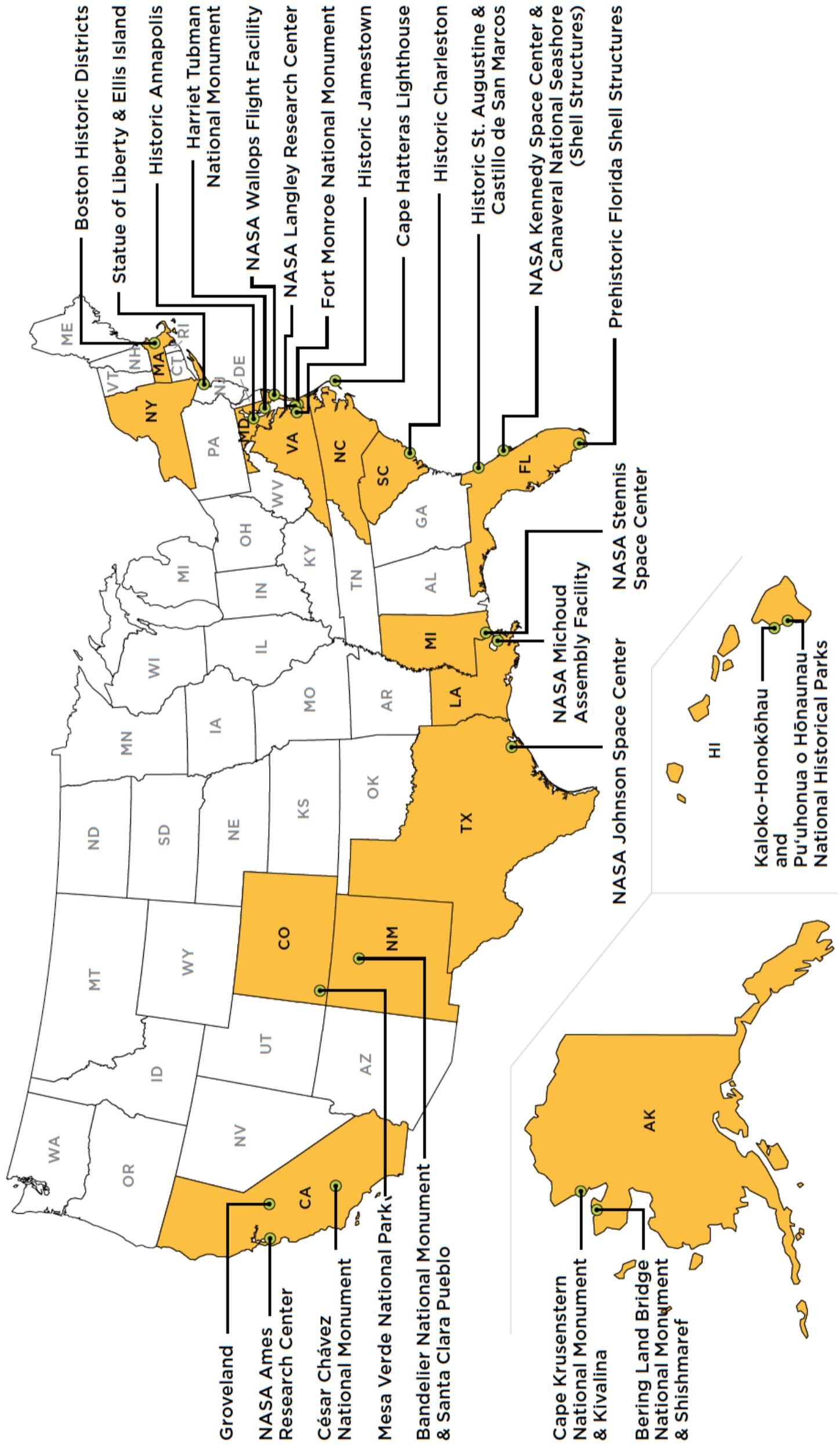
See a short report in Spanish by clicking on, "Florida Landmarks at Risk—[Fact Sheet \(Spanish\)](#)," which is a link in blue type at the webpage for "National Landmarks at Risk."

Learn about the historical importance of each site at the U.S. National Park Service, www.nps.gov/nhl/INDEX.htm, by entering the name of the park in the search box.

Learn about "[Global Warming: Is It Real? How Will It Affect Us? What Can We Do About It?](#)" at www.nps.gov/training.

Map of 15 National Landmarks at Risk

(Examples from 15 States)



Source: http://www.ucusa.org/sites/default/files/legacy/assets/documents/global_warming/National-Landmarks-at-Risk-Full-Report.pdf

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Comprehending Big Numbers

It's hard for the human mind to imagine what large numbers mean. Art can help us grasp their significance. Renowned photographer Chris Jordan, an artist and activist from Seattle, Washington, brings staggeringly large numbers to life in "manipulated digital photographs that are at once alluring and shocking." Students can visit Jordan's website and explore these images (zooming up close or moving away at a great distance), some of them from his best-selling book *Running the Numbers: An American Self-Portrait* (New York & London: Prestel Publishing, 2009).

www.chrisjordan.com/gallery/rtn2/#gyre

Gyre, 2009 8×11 feet, in three vertical panels. Depicts 2.4 million pieces of plastic, equal to the estimated number of pounds of plastic pollution that enter the world's oceans every hour. All of the plastic in this image was collected from the Pacific Ocean.



www.chrisjordan.com/gallery/rtn/#silent-spring

Silent Spring, 2014 44×58 inches and 60×80 inches. Made from 28 graphite drawings by Rebecca Clark. Depicts 183,000 birds, equal to the estimated number of birds that die in the United States every day from exposure to agricultural pesticides.



www.chrisjordan.com/gallery/rtn2/#maya

Stone of the Sun, 2011 44×44 inches and 60×60 inches. Depicts 92,500 agricultural plant seeds, equal to one hundredth of one percent (0.0001) of the number of people in the world today who suffer from malnutrition. To illustrate the entire statistic with 925 million seeds would require ten thousand prints of this image, covering more than eight football fields.



"Our Oceans, Our Plastic"— A Student Contest

Middle (grades 6–8) and high school (9–12) students from around the world are invited to compete in the 2015 Ocean Awareness Student Contest at www.fromthebowseat.org/contest.php. Explore and interpret the connections among the ocean, plastic pollution, and human society with a work of **art, poetry, prose, or film**.

- * Entries may be submitted by an individual or group of unlimited size.
- * Any student may submit (meaning have their name included in) only one entry per category. Therefore, a student may have a maximum of four different submissions, one in each category.
- * There are more than 25 prizes in various categories with cash awards from \$100 to \$1,500.
- * Deadline is June 15, 2015 at 11:59PM EST.

The Ocean Awareness Essay Contest was launched by Linda Cabot in 2011 as a companion to her film, *From the Bow Seat*, an environmental documentary she filmed while sailing the Gulf of Maine with her family, including her two teenaged daughters. After seeing a sense of ocean stewardship blossom in her own daughters during their adventure, Linda founded and funded the Ocean Awareness Essay Contest to inspire ocean stewardship more broadly in students.

Finally, check out the "Rubber Duckies" theme issue of *MLL* (no. 46, January/February 2013) at www.socialstudies.org/publications/archives.

Middle Level Learning

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