



**SOAR**  
*saving our avian resources*  
 soarraptors.org



**Teacher Resources for High School Storyline: Lead in our environment - connection between eagles and you!**

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**Graphic Organizer:**

- [Teacher](#)
- [Student](#)

**Student Readings:**

- [High School](#)

Anchor Phenomenon	Define the Problem	NGSS Performance Expectations
Why do these bald eagles have their heads hanging down?	Is lead in the environment still a problem for humans (are people still presenting to health care professionals with elevated lead levels)? Does lead in the environment impact animals?	HS-LS2-6, HS-LS2-7, HS-LS4-6, HS-ESS3-4, HS-ETS1-3, HS-LS1-3


**Performance Task**


Based on what you learned about bald eagles and the hazards they face, plus how lead affects organisms, and human activity can unintentionally impact organisms, make and defend a claim for or against the use of lead-based ammunition for hunting.

Lesson # with DCI and Big Idea	Phenomena Driven Questions	Phenomena or Problem	Scientific Practices Making Sense of Phenomena using SEPs to investigate DCIs	What We Figured Out Incrementally Build Explanations, Models, or Designs (CCCs)
<p><b>HS #1: Explore SOAR's bald eagle data set</b></p> <p><i>HS-LS2.C Ecosystems: Interactions, Energy, and Dynamics</i> (HS-LS2-6, HS-LS2-7)</p> <p><i>Big Ideas:</i> Bald eagles are admitted to wildlife rehabilitation for many reasons. Human activity can have a negative impact on the environment.</p> <p>Learn more about SOAR</p> <p>Links to Google Sheets:</p> <ul style="list-style-type: none"> <li>• <a href="#">SOAR 2015-2022 Cumulative Data for 9-12 Teachers</a></li> <li>• <a href="#">Student version</a></li> </ul> <p>These are read-only files, so open, then make a copy and save to <b>YOUR</b> Google Drive.</p>	<p>What causes morbidity and mortality to bald eagles in Iowa?</p>	<p>When and why are bald eagles dying in Iowa.</p>	<p><b>Analyze and interpret data</b> Students will analyze and interpret morbidity and mortality data collected on bald eagles admitted to SOAR. <i>(The data sheet includes ten different tabs of data to examine – either as a class, a group assigned to each tab, or selected students assigned to each tab.)</i></p> <ul style="list-style-type: none"> <li>• Primary Morbidity / Mortality All Bald Eagles Admitted to SOAR (and subsets)</li> <li>• Seasonality of Bald Eagles Admitted to SOAR</li> <li>• Lead levels of Bald Eagles Admitted to SOAR</li> <li>• Incidence Abnormal Lead Levels in Bald Eagles Admitted to SOAR</li> <li>• Prevalence of sub-clinical and clinical lead levels in bald eagles tested by SOAR</li> </ul>	<p><b>Cause and effect</b> Do you find any morbidity / mortality of bald eagles that is caused by human action? What could be done to address this cause of bald eagles dying?</p> <p><b>Patterns</b> Students can look for patterns in the data.</p> <p><b>What we figured out</b> Bald eagles are admitted due to injury or illness from trauma, disease, ingesting toxic substances, and from other human-caused injuries. Some die from natural causes (e.g. old age, flooded habitat, food shortage due to drought).</p> <p>Just under half of the bald eagles admitted to SOAR experienced some sort of Trauma. Over 25% of the bald eagles admitted to SOAR have elevated lead levels.</p>


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			<ul style="list-style-type: none"> <li>• Final outcome bald eagles admitted to SOAR</li> <li>• Age and Gender of Bald Eagles Admitted to SOAR</li> <li>• Incidence of Abnormal Lead Levels in Bald Eagles Admitted to SOAR by Age and Gender</li> <li>• Results of X-rays</li> </ul>	
<b>Research Papers:</b> <ul style="list-style-type: none"> <li>• Warner SE, Britton EE, Becker DN, Coffey MJ. 2014. <a href="#">Bald eagle lead exposure in the Upper Midwest</a>. Journal of Fish and Wildlife Management 5(2)</li> <li>• Yaw T, Neumann K, Bernard L, Cancilla J, Evans T, Martin-Schwarze A, Zaffarano B. 2017. <a href="#">Lead poisoning in bald eagles admitted to wildlife rehabilitation facilities in Iowa, 2004–2014</a>. Journal of Fish and Wildlife Management 8(2)</li> <li>• Cruz-Martinez L, Redig P, Deen J. 2012. <a href="#">Lead from spent ammunition: A source of exposure and poisoning in bald eagles</a>. Human-Wildlife Interactions 6(1)</li> </ul>			<b>Popular Press:</b> <ul style="list-style-type: none"> <li>• Ed Britton, Project Leader, Upper Mississippi River NW&amp;FR – Savanna District. <a href="#">Lead Exposure in bald eagles in the Upper Midwest</a>. Inside Region 3 March 31, 2014.</li> <li>• Jeremiah Knupp. <a href="#">Deer entrails give learning an emotional, real-world kick for HHS students</a>. Harrisonburg Citizen December 7, 2018</li> </ul>	

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<p><b>HS #2a: Bald eagles don't eat paint, do they?</b></p> <p><i>HS-LS2.C Ecosystems: Interactions, Energy, and Dynamics</i> (HS-LS2-7)</p> <p><i>Big Ideas:</i> Human activity can unintentionally impact organisms in the environment.</p> <p><b>Note:</b> Both HS #2a and HS #2b look at physiology and / or chemistry of lead (how does lead impact living organisms?)</p>	<p>How are bald eagles getting lead poisoning?</p> <p>What are some avenues of ingestion in their daily lives? Where might lead be found in the environments in which they live?</p>	<p>Many bald eagles admitted to SOAR have elevated lead levels.</p>	<p><b>Analyze and interpret</b> Students will analyze and interpret the deer gut pile and deer carcass x-rays, and eagle x-ray information from SOAR to try to figure out what, if anything the gut piles have to do with the situation.</p> <ul style="list-style-type: none"> <li><a href="#">Google Drive Folder of x-rays</a></li> </ul> <p>Students could review the “seasonality” chart and look at the number of bald eagles that were x-rayed and the results from “Primary Morbidity Mortality.</p> <p>See below for research papers and popular press items to help students to construct explanations for how they believe eagles are getting lead into their bodies.</p>	<p><b>Cause and effect</b> A bald eagle’s contaminated food source can be a way for toxins to get in the body.</p> <p><b>What we figured out</b> Bald eagles are eating deer gut piles and carcasses left by hunters. These gut piles can contain lead fragments, if the deer have been shot with lead ammunition. Since bald eagles scavenge on deer, that is one possible way lead is getting into their bodies.</p>
<p><b>Research Papers:</b></p> <ul style="list-style-type: none"> <li>Pokras, M. A., and M. R. Kneeland. 2009. <a href="#">Understanding lead uptake and effects across species lines: A conservation medicine approach</a>. In R. T. Watson, M. Fuller, M. Pokras, and W. G. Hunt (Eds.). Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans. The Peregrine Fund, Boise, Idaho, USA.</li> <li>Hunt, G.W. et al. 2006. <a href="#">Bullet Fragments in Deer Remains: Implications for Lead Exposure in Avian Scavengers</a>. Wildlife Society Bulletin 4(1):167–170</li> </ul>		<p><b>Popular Press:</b></p> <ul style="list-style-type: none"> <li>Lahner, L.L., and Franson. J.C., 2009, <a href="#">Lead poisoning in wild birds: U.S. Geological Survey Fact Sheet</a> 2009–3051, 4 p.</li> <li><a href="#">Lead Contamination in Wildlife</a> – Iowa State University Extension &amp; Outreach website</li> <li><a href="#">Winged Warnings: Metal Madness</a>. 10 Sept 2014, Environmental Health News website (<a href="#">PDF with no photos / graphics</a>)</li> </ul>		

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<p><b>HS #2b: The deception of lead</b></p> <p><i>HS-LS1.A</i> (HS-LS1-3)</p> <p><i>Big Ideas:</i> Human activity can unintentionally impact organisms in the environment.</p> <p><b>Note:</b> Both HS #2a and HS #2b look at physiology and / or chemistry of lead (how does lead impact living organisms?)</p>	<p>Why is lead such a problem?</p>	<p>What is the physiology and chemistry of lead? How does lead get into a body (absorbed, ingested, inhaled) and what is the impact on different animals? (We'll focus on humans and eagles.)</p> 	<p><b>Ask questions and define problems</b> Students will use research papers and popular press articles to learn about the effects of lead on the human body (e.g. bones, nervous system, high blood pressure, kidney damage, etc.).</p> <p>The articles below will provide the “Ask an Expert” information that students may need to construct explanations for how they believe bald eagles are getting lead into their bodies.</p>	<p><b>Structure and function</b> Lead mimics calcium in vertebrates. Lead disrupts normal physiology.</p> <p><b>What we figured out</b> Students will learn that lead gets absorbed into the blood and stored in bones of animals – including people - similar to the way calcium does because lead mimics calcium.</p> <p>Animals and people naturally absorb small amounts of copper, knowing it is copper.</p>
<p><b>Research Papers / Advanced Reading:</b></p> <ul style="list-style-type: none"> <li>Lead Toxicity: What are Possible Health Effects from Lead Exposure ATSDR (<a href="#">website</a> and <a href="#">PDF available</a>)</li> <li>Pokras, M. A., and M. R. Kneeland. 2009. <a href="#">Understanding lead uptake and effects across species lines: A conservation medicine approach</a>. In R. T. Watson, M. Fuller, M. Pokras, and W. G. Hunt (Eds.). Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans. The Peregrine Fund, Boise, Idaho, USA.</li> </ul>			<p><b>Popular Press:</b></p> <ul style="list-style-type: none"> <li><a href="#">Learn about Lead – Environmental Protection Agency</a> website</li> <li><a href="#">Lead Fact Sheet</a> from the US Centers for Disease Control</li> </ul>	

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<p><b>HS #2c: Jen the Mom</b></p> <p><b>HS-LS2.C</b> (HS-LS4-6, HS-LS2-7)</p> <p><i>Big Ideas:</i> Human activity can unintentionally impact organisms (humans) in the environment</p> <p><a href="#">Google Folder for Jen the Mom</a></p>	<p>How did Jen’s baby get lead in his blood?</p>	<p>Jen’s baby had high levels of lead in his blood.</p>  <p>(photo of x-ray taken of two 1-pound packages of ground venison)</p>	<p><b>Construct explanations</b></p> <p>Students will analyze the information and links <a href="#">in Jen’s story</a> to determine how and why Jen’s baby had elevated blood lead levels. Students will make a claim as to what caused the high levels of lead in the baby’s blood based on the evidence they have.</p>	<p><b>Cause and effect</b></p> <p>Pieces of lead ammunition in the processed deer meat were absorbed by the baby’s body.</p> <p><b>What we figured out</b></p> <p>The hunter used copper slugs when hunting deer. The deer was processed at a local meat locker where you are not guaranteed JUST your ground venison. The ground venison they received must have included meat hunted with lead ammunition.</p>
<p><b>Research Papers / Advanced Reading:</b></p> <ul style="list-style-type: none"> <li>Bellinger, David C et al. 2013. <a href="#">Health Risks from Lead-Based Ammunition in the Environment</a>. Environmental Health Perspectives. Vol 121, No 6.</li> <li>Pain DJ, Cromie RL, Newth J, Brown MJ, Crutcher E, et al. (2010) <a href="#">Potential Hazard to Human Health from Exposure to Fragments of Lead Bullets and Shot in the Tissues of Game Animals</a>. PLoS ONE 5(4): e10315.</li> </ul>			<p><b>Popular Press:</b></p> <ul style="list-style-type: none"> <li>Lead ammo in hunted meat: Who’s telling hunters and their families? Environmental Health News. (<a href="#">PDF with no images</a> and <a href="#">website link</a> – check first if still available.)</li> <li><a href="#">Lead Dust from Firearms Can Pose a Silent Health Risk</a>. National Public Radio, May 10, 2017.</li> <li><a href="#">KWQC Investigates Lead in Venison</a> (PDF) Videos also available: <ul style="list-style-type: none"> <li><a href="#">Lead in Venison</a>, part 1</li> <li><a href="#">Lead in Venison: Iowa health official’s actions</a>, part 2</li> <li><a href="#">Lead in Venison: Iowa natural resource official’s actions</a>, part 3</li> </ul> </li> </ul>	



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<p><b>HS #3: Consumer’s Buying Power</b></p> <p><i>HS-ETS1.B</i> (HS-ETS1-3)</p> <p><i>Big Ideas:</i> Non-lead ammunition will be a safer alternative for hunting, providing lead-free food for humans and not leaving lead on the landscape. When consumers buy (demand) a certain type of product, retail stores will stock (supply)!</p>	<p>I’m only one person, what can I do, what can I do to help reduce my lead exposure?</p> <p>What can be done to reduce lead exposure to animals and people?</p> <p>What are the differences between lead and non-lead ammunition?</p>	 <p>Look at the “cost-effective” conservation when steel shot was required for waterfowl hunting.</p>	<p><b>Analyze and interpret data</b></p> <p>Students should read about lead and non-lead ammunition availability, performance, and cost. Read information from both the ammunition industry and science-based resources.</p>	<p><b>Structure and function</b></p> <p>Lead bullets and slugs fragment into hundreds of pieces upon impact and can be found several inches from the site of the wound in large game animals. Copper bullets and slugs retain about 98% of its weight.</p> <p><b>What we figured out</b></p> <p>There are safer and just as effective alternatives to lead ammunition. More information available on SOAR website: <a href="#">Non-toxic Alternatives</a></p>
<p><b>Research Papers / Advanced Reading:</b></p> <ul style="list-style-type: none"> <li>Anderson, W., Havera, S., &amp; Zercher, B. (2000). <a href="#">Ingestion of Lead and Nontoxic Shotgun Pellets by Ducks in the Mississippi Flyway</a>. <i>The Journal of Wildlife Management</i>, 64(3), 848-857. (access is limited, but can read abstract)</li> <li><a href="#">Lead Availability in Slug-Shot White-tailed Deer</a>, Preliminary report 2009, Kay Neumann, SOAR.</li> </ul> <p><b>SOAR updates this web page as new research becomes available:</b> <a href="https://soarraptors.org/research-articles-and-information/">https://soarraptors.org/research-articles-and-information/</a></p>			<p><b>Popular Press:</b></p> <ul style="list-style-type: none"> <li>Bartha, Carle and Lehman, Phil. 2010. <a href="#">How Good are Copper Bullets, Really?</a> (Understand that most of Iowa big game hunting seasons are for shotgun slugs as compared to the rifle bullets tested in Wisconsin.)</li> <li>Steinkopf-Frank, Hanna. 2018. <a href="#">Can Hunters and Activists Team Up to Phase Out Lead Bullets?</a> In These Times, January 8, 2018.</li> <li><a href="#">Leopold Hunt Talk Radio Podcast episode 87, Lead-free ammo and hunting with raptors:</a> In this episode, Randy is joined by his production leader, Marcus Hockett, and two fanatic hunters who happen to be experts on raptors and hawking, Chris Parish and Leland Brown.</li> <li><a href="#">Condensed Summary of a 2008 Minnesota Department of Natural Resources Bullet Fragmentation Study.</a></li> </ul>	

## Performance Task

Based on what you learned about bald eagles and the hazards they face, plus how lead affects organisms, and human activity can unintentionally impact organisms:

- make and defend an argument or counter-argument based on data and evidence about why non-lead ammunition would be a safer alternative to lead-based ammunition.
  - Brainstorm as a class who the stakeholders are in this conversation.
    - Have a student or student teams research different stakeholder to help gain perspective for the argument / counter-argument.
  - Brainstorm and decide as a class which group is the appropriate audience for your arguments and counter-arguments.
  - Even though ammunition cost and effectiveness (performance) were not specifically discussed in lesson 3, students may want to research this by interviewing family members, individuals within the community, and business owners / staff.

If students are struggling with who the stakeholders in the lead / non-lead ammunition discussion, here are prompts to help:

- Is there a local conservation agency?
- Are their local or regional hunter and angler clubs or “fin and feather” groups (both consumptive – hunting - and non-consumptive)?
- Is there a nearby early childhood care provider, child care center, preschool?
- What about local government?

## Extension Ideas / Topics:

Are only bald eagles in Iowa affected by lead? (i.e. is this just an Iowa problem)

Can bald eagles ingest lead from eating fish or waterfowl?

Are other birds impacted by ingesting lead?