WILD WISE: COEXISTING WITH CARNIVORES

TEACHER GUIDE 2019-2020

How can humans peacefully coexist with carnivores—meeting our own needs while also allowing carnivores to meet *their* needs?”

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ACRONYMS

AZA	Association of Zoos and Aquariums	aza.org
CCC	Crosscutting Concept	
CWC	Coexisting with Carnivores	zoo.org/wwcwc
DCI	Disciplinary Core Idea	
IMLS	Institute of Museum and Library Sciences	imls.gov
ISD	Issaquah School District	issaquah.wednet.edu
NGSS	Next Generation Science Standards	nextgenscience.org
SEP	Science and Engineering Practice	
WDFW	Washington Department of Fish and Wildlife	wdfw.wa.gov
WPZ	Woodland Park Zoo	zoo.org
WWO	Western Wildlife Outreach	westernwildlife.org

INTRODUCTION
COEXISTING WITH CARNIVORES
2019-2020

BACKGROUND

Communities in the Issaquah-Sammamish area frequently encounter carnivores (black bears, cougars, bobcats, coyotes and raccoons) with potential opportunities for conflict. From this need, and a desire to engage in student-driven inquiry, Wild Wise: Coexisting with Carnivores (CWC) began in 2012 as a collaboration between Woodland Park Zoo and Issaquah Middle School teacher. For the 2016-17 school year, the program expanded to include three middle schools in the Issaquah School District (ISD). In 2017, the program was adopted district-wide to reach over 1400 students and more than 10 teachers across all five middle schools in the district.

NEW FOR 2019-2020

Based on surveys and interviews of teachers, ISD leader feedback, and input from NGSS experts and instructors, this year we have updated the CWC curriculum in the following ways:

- **More explicit alignment to NGSS in the Teacher Guide**: The CWC curriculum is very strong in engaging students in scientific practices, a core dimension of the Next Generation Science Standards (NGSS). The NGSS asks teachers to facilitate engagement with scientific practices, a major shift from previous teaching standards and expectations that primarily focused on content knowledge. In order to better support teachers and instructors in these new expectations, we created more explicit connections to NGSS through Facilitator Notes and a Facilitation Guide.
- **Student Packets**: The new Student Packet helps make student thinking visible. It also highlights the components that are needed for their final project. The zoo will print and distribute the Student Packets to teachers. At the end of the unit, zoo staff will be copying and/or collecting student packets to use as artifacts in evaluating the program (students and/or teachers can keep them throughout the unit).
- **Installation of field cameras in the fall (Fall Visit)**: Students get excited when they see photos of carnivores in their area, and are usually eager to use the field cameras for their investigations. However, students typically have a couple weeks to gather data, which means they might only get a handful of photos for their investigation. We also received feedback from teachers that the field cameras were a lot of trouble to get permissions from parents to install at students' houses.

  This year, we added a date in the fall for zoo staff to install field cameras on or near school grounds. As this is a new element, we made it optional for students to join zoo staff. In the future, it will be a great opportunity for students to get hands-on experience and personal investment in the ecosystems around their school.
- **Adjustments to the tour during the zoo visit (Element 2)**: We anticipate that the new Living Northwest Trail (formerly Northern Trail) will still be under construction during winter and spring 2020. As of November 2019, we anticipate that students will still be able to go on the tour and go to the typical checkpoints at wolves, bears and elk.
- **More support for student-driven data analysis (Element 5)**: Using an online survey is one of the most popular methods selected by students for collecting data. However, it is the least hands-on portion of the curriculum. Therefore, we added recommendations for tools that students can use to collect and analyze data themselves and an optional visit from zoo staff to help analyze results.
- **New format for All School Community Event (Element 8)**. Previously, zoo staff selected two student groups from each school to present. In order give more students the chance to present, we are planning to use a science fair format. Students will give an in-class presentation to zoo staff in the classroom and prepare a tri-fold board for the All School Community Event.

FUTURE CHANGES

Funding. The existing grant for CWC ends in October 2020. WPZ and ISD will need to find additional funding for the program to continue in the 2020-2021 school year and beyond. For the next phase of the program, we are focusing on expanded professional development for teachers and co-development of curriculum with participating teachers. The goals would be for teachers to gain more familiarity and confidence in facilitating scientific practices and be more directly involved in adapting and integrating the CWC program into their existing curriculum. As of September 2019, the zoo and ISD are applying for a grant extension and additional funding.

Assessments aligned to NGSS: The NGSS Framework specifies that science assessments should not assess students' understanding of core ideas (content) separately from their abilities to use the practices of science and engineering (REF Appendixes 48). Moving forward, we will continue updating assessments (including embedded assessments) to reach this goal.

ACKNOWLEDGEMENTS

Coexisting with Carnivores is made possible in part by the Institute of Museum and Library Services MA-20-17-0480-17. We also thank the following organizations for their support: Issaquah Schools Foundation, Tulalip Tribes, Horizons Foundation, Ferguson Foundation, Carter Subaru, and the Association of Zoos & Aquariums (AZA) Conservation Grants Fund.

CONTACTS

The following Woodland Park Zoo and Issaquah School District staff are involved in the facilitation and delivery of the CWC program and are available to assist you during the school year. **Not sure who to contact at Woodland Park Zoo? Email your question to wild.wise@zoo.org and it will be routed to the correct person.**

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UNIT OVERVIEW
COEXISTING WITH CARNIVORES
2019-2020

UNIT SUMMARY

Who: Woodland Park Zoo (WPZ) staff and Issaquah School District (ISD) teachers facilitate the program for approximately 1500 students in 6th grade life sciences classes across all five middle schools in the district.

When: Majority of the program takes place February through early June of the school year, coinciding with the ISD Ecology curriculum. There is also a school visit to install camera traps in the fall.

Time: 12 to 16 or more periods total; plan for more time the first year.

Where: Majority of the program takes place in the classroom or on school grounds. There is also a field trip to Woodland Park Zoo and a culminating event at Issaquah Middle School.

DESCRIPTION

Coexisting with Carnivores is a collaborative program between Woodland Park Zoo and the Issaquah School District middle schools. During the program, students engage in scientific practices outlined in the Next Generation Science Standards such as developing investigative research questions, planning and carrying out investigations, analyzing and interpreting data and constructing scientific explanations. Student projects are guided by the essential question:

> **"How can humans peacefully coexist with carnivores—meeting our own needs while also allowing carnivores to meet *their* needs?"**

As the culmination of the program, students present their research findings and evidence-based recommendations for coexisting with carnivores to their peers and community.

CALENDAR 2019-2020

If you need to change any coordinated date (in bold) in your schedule, please contact zoo staff as soon as possible (page 4). We may not be able to provide zoo staff for facilitation if changes are made less than two weeks (10 school days) in advance.

Table 1. Calendar dates by school. Dates in **bold** are coordinated between the zoo and schools; otherwise dates are flexible because they are facilitated by the teacher. Dates with an asterisk (*) may be facilitated by zoo staff OR teachers.

	Beaver Lake	Issaquah	Maywood	Pacific Cascade	Pine Lake
***Fall Visit**	**Fri Nov 1**	**Mon Nov 4**	**Tues Nov 5**	**Fri Nov 8**	**Thurs Nov 7**
E1: Pre-assess. & Carnivore Map					
E2: Zoo Visit	**Tues Mar 3**	**Thu Mar 5**	**Tues Mar 10**	**Fri Mar 13**	**Thu Mar 12**
E3: Investigative Question					
***E4: Research Methods**	**TBD**	**Mon Mar 23**	**Tues Mar 24**	**Fri Mar 27**	**Thu Mar 26**
WWO Visit					
WWO Backup					

	Beaver Lake	Issaquah	Maywood	Pacific Cascade	Pine Lake
***E5: Data Analysis**	**Fri Apr 24**	**Mon May 4**	**Tue Apr 28**	**Fri May 1**	**Thu Apr 30**
E6: Recommend. and Presentation					
E7: Sharing Findings	**Thu May 14 Fri May 15**	**Thu May 28 Fri May 29**	**Mon May 18 Tue May 19**	**Tues May 26**	**Thu May 21 Fri May 22**
E8: All School Community Event	**Wednesday, June 10**				

* = Optional facilitation by the zoo (teachers can opt to do this on their own)
Bold = Date coordinated with zoo and/or WWO

UNIT OBJECTIVES

The IMLS grant narrative outlines the following outcomes for middle school students:

- Students successfully engage in practices of scientific inquiry.
- Students demonstrate increased understanding of carnivore ecology and carnivores' roles in ecosystems.
- Students demonstrate increased appreciation of local carnivores.
- Students demonstrate increased awareness about behaviors that contribute to a peaceful coexistence with carnivores.

The relevant Woodland Park Zoo Operational Goals addressed in this program include the following:

- Participants demonstrate increased hopefulness about the future for conservation.
- Participants demonstrate increased intention to take pro-environmental action.
- Participants demonstrate increased sense of inclusion and participation among audiences who have previously experienced geographic, economic, cultural or ability barriers.

ASSESSMENTS AND EVALUATION

Methods for evaluating program objectives are as follows:

- All students complete a digital pre- and post-assessment. The survey measures knowledge of local carnivores, attitudes toward carnivores, interpretation of data and maps, knowledge of predator-prey relationships, human impacts on the environment, and solutions for peaceful coexistence with carnivores.
- All students will receive a Student Packet which they will use to participate in the program. Zoo staff will collect, copy, and return the Student Packets at the end of the unit to use them to evaluate student grasp of curriculum material.
- Teachers participate in a written pre- and post-assessment to measure confidence in teaching student-led investigations. They may also be interviewed for feedback on the unit components.

See also STEM Teaching Tools on Assessment.

CONNECTIONS TO STANDARDS: NGSS

Students need to be exposed to the three dimensions of NGSS in many contexts and activities in order to become familiar with them enough to achieve the performance expectations. Table 2 shows the touchpoints of the dimensions across the components of this unit.

Table 2. Overview of the connections between the Coexisting with Carnivores unit and the three dimensions of NGSS. Multiple touchpoints on that NGSS component are present within that Element if there are multiple dots.

NGSS Science and Engineering Practices	**FV/E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7/E8**
1. Ask questions/ define problems		●	●●●		●●	●	
2. Develop and use models	●						
3. Plan and carry out investigations				●●●●			
4. Analyze and interpret data	●				●●●●●		
5. Use mathematics and computational thinking			●		●●		
6. Construct explanations/design solutions						●●●●	
7. Engage in argument from evidence							●●
8. Obtain, evaluate, and communicate information							●
NGSS Crosscutting Concepts	**FV/E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7/E8**
1. Patterns	●		●		●●		
2. Cause and effect: Mechanism and explanation			●				
3. Scale, proportion, and quantity							
4. Systems and system models		●					
5. Energy and matter: Flows, cycles, and conservation							
6. Structure and function							
7. Stability and change		●				●	
NGSS Disciplinary Core Ideas (Abbr.)*	**FV/E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7/E8**
Life Sciences							
LS2.A: Interdependent relationships in ecosystems	●	●	●			●	
LS2.C: Ecosystem dynamics, functioning, and resilience		●				●	
Earth and Space Sciences							
ESS3.C: Human impacts on Earth systems		●	●			●	

*See Facilitation Guide for Activities (p. 8) for detailed content descriptions of each core idea

PROGRAM MATERIALS AND PREPARATION

To facilitate communication between the zoo, teachers, and the district, below is a month-by-month timeline.

Time	**Typical Activities**
Fall (Sept-Nov)	Fall Visit Finalize Element dates with zoo staff
January	Finalize WWO visit dates
February	Zoo collects field cameras and sends photos Mid-winter break Pre-assessment (part of Element 1) Element 1: Pre-assessment and Carnivore Map
March	Element 2: Zoo Visit Element 3: Investigative Question

	Element 4: Methods and Data Collection WWO Visit (March or April)
April	Spring break Data Collection continues (part of Element 4) Element 5: Data Analysis
May	Element 6: Recommendation and Presentation Building Element 7: Sharing Findings
June	Post-assessment (part of Element 7) Element 8: All School Event

FACILITATION GUIDE FOR ACTIVITIES

This Facilitation Guide provides assists for facilitation and links to in-depth resources for facilitators to learn and incorporate current practices into their teaching.

STUDENT PACKET

When an activity includes a task that students complete within their **Student Packets**, an icon appears next to the task on the right (see example to the right).

SCIENCE TALKING, WRITING, AND DRAWING

When an activity includes an opportunity for productive science communication (through talking, writing, and/or drawing), an icon appears next to the task on the right (see example to the right). These are only suggestions—science talk and communication can be utilized whenever students need additional support in clarifying ideas.

The science and engineering practices in the NGSS are deeply social and require that students communicate. Many studies have shown that student communication is a very productive class activity and that it results in deep sense-making for many kinds of students. However, it is often challenging to facilitate productive conversations, especially with students who are not accustomed to talking in their science classes. Teachers can use tools to scaffold student science talk.

Additional information and tools for productive classroom talk can be found in these STEM Teaching Tools briefs:

- STEM Teaching Tool #6: How Can I Get My Students to Learn Science by Productively Talking with Each Other? (Bacolor, Cook-Endres, Clark, & Allen, 2014)
- STEM Teaching Tool #35: How Can I Foster Curiosity and Learning in My Classroom? Through Talk! (Wingert, 2016)
- STEM Teaching Tool #48: How Can Teachers Guide Classroom Conversations to Support Students' Science Learning? (Morrison & Rhinehart, 2017)
    - Talk Resource Tool: Cards Sets to support specific science communication practices and explicit communication practices in English more generally
    - Talk Resource Tool: Partner Conversational Supports to help students work together to clarify, support with evidence, and extend their thinking and reasoning
    - Talk Resource Tool: Pre- and Post-Talk Writing Supports provide a familiar structure for students to engage in around classroom talk activities

FACILITATOR NOTES

Throughout the Activities, you will see Facilitator Notes that provide explicit connections between the curriculum to appropriate standards and/or pedagogical practices. Below is an example of a Facilitator Note:

Science and Engineering Practices [EXAMPLE]

Engaging in Argument

This practice allows scientists and students to make their case for a justified claim. In this example, students are using argumentation to determine the best interpretation of a data set.

The icon in front of the note identifies the type of skill or practice and refers to the corresponding section below (e.g. the example above refers to Scientific and Engineering Practices).

USING PHENOMENA TO TEACH NGSS

Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. By centering science education on phenomena that students are motivated to explain, the focus of learning shifts from learning about a topic to figuring out why or how something happens. For example, instead of simply learning about the topics of relationships within ecosystems, students are engaged in building evidence-based explanatory ideas that help them figure out how reintroducing wolves can impact rivers and other natural resources.

Phenomena

Science instruction has often been centered on learning general knowledge rather than exploring and explaining specific phenomena, such as directly teaching Newton's Laws of Motion rather than learning about them through an engineering design challenge. By exploring phenomena, students have opportunities to apply science and engineering practices and to build their own larger scientific conceptions and identities.

Instructional sequences are more coherent when students investigate compelling natural phenomena by engaging in the science and engineering practices. A good phenomenon:

- Builds upon every day or family experiences: who students are, what they do, where they came from
- Requires students to develop understanding of and apply a broad sequence of science practices through first- or second-hand investigations
- Is too complex for students to explain after a single lesson
- Is observable to students, with the aid of scientific procedures (e.g., in the lab), or technological devices (telescopes, microscopes), video presentations, demonstrations, or surface patterns in data.
- Can be a case (pine beetle infestation), something that is puzzling (why isn't rainwater salty?), or a wonderment (how did the solar system form?)
- Has relevant data, images, and text to engage students in the range of ideas students need to understand
- Has an audience or stakeholder community that cares about the findings or products

Additional information about phenomena can be found in the following STEM Teaching Tools:

- STEM Teaching Tool #28: Qualities of a Good Anchor Phenomenon for a Coherent Sequence of Science Lessons (Penuel & Bell, 2016)
- STEM Teaching Tool #31: How to Launch STEM Investigations that Build on Student and Community Interests and Expertise (Bell, Morrison, & DeBarger, 2015)
- STEM Teaching Tool #42: Using Phenomena in NGSS-Designed Lessons and Units (Achieve, 2016)

NEXT GENERATION SCIENCE STANDARDS

The Next Generation Science Standards (NGSS) reflect a new vision for American science education in which science education reflects the interconnected nature of science as it is practiced and experienced in the real world (NGSS Lead States, 2013, p. 1) Students actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of disciplinary core ideas. (NRC, 2012, p. 218)

Dimension 1: Scientific and Engineering Practices

A key part of the NGSS is for students to learn science content within the context of scientific practices, or the doing of science (NRC, 2012). Additional information about the significance and progression of SEPs across grade bands can be found in Chapter 3 of the Framework (NRC, 2012) and NGSS Appendix F (NGSS Lead States, 2013).

Additional information can be found in these related STEM Teaching Tools:

- STEM Teaching Tools #14: Next Generation Science Standards: What's Different, and Do They Matter? (Bell, Shouse, & Peterman, 2014)
- STEM Teaching Tools #3: Practices Should not Stand Alone: How to Sequence Practices in a Cascade to Support Student Investigations (Bell & Van Horne, 2014)
- STEM Teaching Tools #8: What is Meant by Engaging Youth in Scientific Modeling? (Wingert, Wagner, Shouse, Spodaryk, & Chowning, 2015)

Scientific and Engineering Practices (SEPs)

(1) **Asking Questions and Defining Problems** is essential to students for developing scientific habits of mind and becoming critical consumers of scientific knowledge.

(2) **Developing and Using Models** allows scientists and students to better visualize and understand a phenomenon under investigation or develop a possible solution to a design problem. Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations.

(3) **Planning and Carrying Out Investigations** allows scientists and students to test explanatory models and predictions.

(4) **Analyzing and Interpreting Data** reveals patterns and relationships in data and allows results to be communicated to others. It brings out the meaning and relevance of data so it can be used as evidence.

(5) **Using Mathematics and Computational Thinking** allows scientists and students to represent variables and relationships symbolically, predict outcomes, and visualize and analyze data. Mathematics and computation are powerful tools and models for communicating information and describing and predicting phenomena.

(6) **Constructing Explanations and Designing Solutions** allows scientists and students to provide explanations that illuminate the nature of a phenomena, predict future events, or make inferences about past events.

(7) **Engaging in Argument from Evidence** allows scientists and students to make their case for a justified claim. It can determine the best experimental design, most appropriate technique for data collection and analysis, or the best interpretation of a data set.

(8) **Obtaining, Evaluating, and Communicating Information** allows scientists and students to use words, diagrams, charts, graphs, images, symbols, and mathematics to create, utilize, and disseminate scientific knowledge.

Dimension 2: Crosscutting Concepts (CCCs)

Crosscutting concepts bridge and unify the study of science and engineering through their common application across disciplinary fields. Additional information about and progressions of Crosscutting Concepts can be found in Chapter 4 of the Framework and Appendix G of the NGSS.

Crosscutting Concepts (CCCs)

(1) **Patterns**. Observed patterns of forms and events guide organization and classification, and prompt questions about relationships and the factors that influence these relationships.

(2) **Cause and Effect**: Mechanism and Explanation. A major activity of science is investigating and explaining causal relationships and the mechanisms by which those relationships are mediated; such mechanisms can then be tested across contexts and used to predict and explain events in new contexts.

(3) **Scale, Proportion, and Quantity**: In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

(4) **Systems and System Models**: Defining the system under study—specifying its boundaries and making an explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

(5) **Energy and Matter: Flows, Cycles, and Conservation**. Tracking flows of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

(6) **Structure and Function**: The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

(7) **Stability and Change**: For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements.

Dimension 3: Disciplinary Core Ideas (DCIs)

The DCIs are arranged under three broad fields of study, or disciplines: Physical Sciences (PS), Life Sciences (LS), and Earth and Space Sciences (ESS). The framework focuses on a limited number of core ideas to allow teachers and students more time for in-depth exploration of topics. Each discipline contains several core ideas, for a total of more than 38 core ideas. Each core idea contains a learning progression so that student thinking increases in sophistication across grade bands.

Only core ideas that are relevant to this unit and grade band are shown here. All of the DCIs and learning progressions can be found in Chapters 5 through 7 of the Framework (NRC, 2012) and summarized in Appendix E of the NGSS (NGSS Lead States, 2013).

Disciplinary Core Ideas (DCIs)

LS2.A: Interdependent Relationships in Ecosystems. How do organisms interact with the living and nonliving environments to obtain matter and energy?

Grades 6-8: "Organisms and populations are dependent on their environmental interactions with both other living things and non-living factors. Growth of organisms and population increases are limited by access to resources. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources… Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms…." (NRC, 2012, p. 152)

LS2. C: Ecosystem Dynamics, Functioning, and Resilience: What happens to ecosystems when the environment changes?

Grades 6-8: "Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations…" (NRC, 2012, p. 155)

ESS3.C: Human Impacts on Earth Systems. How do humans impact the Earth system?

Grades 6-8: "Human activities have altered the biosphere, sometimes damaging or destroying natural habitats. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise." (NRC, 2012, p. 196)

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FALL VISIT

FIELD CAMERA INSTALLATION

Student Driving Question: How can I tell what animals are in my community?

SUMMARY

Who: Zoo-facilitated

When: November (for exact date, see Calendar 2019-2020 on page 5)

Time: 1 period

Where: School grounds

DESCRIPTION

Staff from Woodland Park Zoo install field cameras on or near school grounds. Students examine a map to help identify possible camera sites or join zoo staff to help install the cameras (if zoo staff already identified sites). Zoo staff or teachers introduce students to community-based science research. In early February, zoo staff will arrange a time to collect SD cards and send photos to teachers before Element 1 so students can examine the photos as phenomena.

OBJECTIVES

By the end of this element, students will be able to…

- Follow written instructions to set up and collect data from a field camera (with assistance from an adult) to serve as phenomena.

CONNECTIONS TO NGSS

If students participate, consider this lesson to be a part of Element 1.

MATERIALS AND PREPARATION

- ❑ Obtain permission to install cameras on school grounds (contact ISD).
- ❑ Screen-capture and print map of school grounds property via King County Parcel Viewer (https://www.kingcounty.gov/services/gis/Maps/parcel-viewer.aspx).
- ❑ Print at least one copy of **Camera Trapping and eMammal Teacher Guide** (www.zoo.org/wwcwc).
- ❑ Make at least one copy per camera of the **Camera Trap Data Sheet** (www.zoo.org/wwcwc).
- ❑ Obtain phone or device with GPS.
- ❑ Gather remote camera kits with the following items, and contact ISD's Curriculum Specialist (p. 4) if missing:
  - ❑ Five remote field cameras
  - ❑ Five metal camera cases (optional)
  - ❑ 40 AA-batteries (eight batteries per camera)
  - ❑ Ten 16GB-SD-memory cards (two cards per camera)
  - ❑ Five python cable locks
  - ❑ Five small locks for camera case (if included)

- ❑ Three field guide books
- ❑ Obtain SD card reader such as laptop or phone (optional)

ACTIVITIES

1. Use school boundaries map to identify possible camera sites.

If students cannot go out in the field, they can look at an aerial view of the school on Google Maps and suggest places to install a field camera. Suggested questions:

- What should we consider before installing a field camera? (Traffic, people, etc.)
- Where might be useful or good locations to install the field camera—and why?

2. Walk to the locations with kits to choose site and install cameras.

Follow instructions on p. 3 of the Camera Trapping and eMammal Teacher Guide.

3. Return five to seven days later to check on camera.

Bring an SD card reader with you if you have one to check photos in the field. Otherwise, you can swap the SD cards, but you will have to return if the initial photos reveal any issues or you need to move the camera. Make sure no vegetation has been triggering the camera too much, that the camera has not attracted the attention of people, etc.

4. Return at least once a month to check camera, batteries, and SD cards.

If available, zoo staff may assist with checking cameras. If teachers want to retrieve the SD cards, zoo staff may retrieve/drop off SD cards via the school front desk.

ELEMENT 1

PRE-ASSESSMENT AND CARNIVORE MAP

Student Driving Question: Where are carnivores in my community?

SUMMARY

Who: Teacher-facilitated

When: Late February to early March (for exact date, see Calendar 2019-2020 on page 5)

Time: 2.5 periods, with an optional homework assignment in between first and second sessions

Where: Classroom (and computer lab for assessment)

DESCRIPTION

In this introductory lesson, students begin exploring where carnivores are in their community. Before starting the lesson, teachers administer a digital pre-assessment for program evaluation to students. Then, students look at the photos from their field cameras and share what they already know about ecosystems and local carnivores (black bears, cougars, bobcats, coyotes, and raccoons). For homework, students interview an adult about their experience with local carnivores. In the second class session, students add all the sightings to a carnivore community map and begin asking questions about what causes carnivores to be seen in particular areas. Teachers introduce the CWC program and local carnivores.

OBJECTIVES

By the end of this element, students will be able to…

- Analyze, interpret, and ask questions about patterns in local carnivore sightings using maps (graphical displays).

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Develop and Use Models
- Analyze and Interpret Data

Crosscutting Concepts

- Patterns

Disciplinary Core Ideas

- LS2.A: Interdependent relationship in ecosystems

MATERIALS AND PREPARATION

- ❑ Reserve computer access (with internet) for student pre-assessment (link at www.zoo.org/wwcwc).
- ❑ Print/Locate sample field camera photos (collected and organized by zoo)
- ❑ Receive/Obtain remote camera GPS coordinates
- ❑ Distribute Student Packets sheets (E1: Community Interview, E1: Carnivore Map Patterns)

- ❑ Download CWC Introduction PowerPoint (www.zoo.org/wwcwc)

Option A: Create a Carnivore Map

- ❑ Prepare digital map (see Appendix B: Create and Edit Digital Maps)

  OR

- ❑ Gather materials for paper map
    - ❑ Paper map, printed by the zoo
    - ❑ Index cards or sticky notes
    - ❑ String or yarn
    - ❑ Tape or push pins

Option B: Use Carnivore Spotter

- ❑ Become familiar with the zoo's Carnivore Spotter (carnivorespotter.org)

ACTIVITIES

DAY ONE: ADD FIELD CAMERA PHOTOS TO MAP

1. Administer the digital student pre-assessment (25 minutes)

Give students as much time as they need to complete the assessment. Reassure students that the assessment is used to improve the CWC project, not their grade, and their responses will be anonymous.

The low-stakes pre-assessment measures student attitudes towards carnivores, their ability to support claims with evidence, analyze spatial patterns of carnivore activity and understanding of actions that can reduce conflict with carnivores. The assessment can be completed during a separate class period.

Disciplinary Core Ideas

Prior knowledge: What should my students already know?

The DCI were designed to integrate learning progressions, so each grade band level builds on previous knowledge from previous grade bands. Therefore, students in 6th grade are expected to demonstrate an understanding of the 3rd to 5th grade band level DCIs. If your students have not yet established this knowledge, you may need to provide supplemental information or scaffolds.

LS2.A: Interdependent relationships in ecosystems. *Grades 3-5*: "The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil" (NGSS Lead States, 2013, p. 43).

LS2.C: Ecosystem Dynamics, Functioning, and Resilience. *Grades 3-5*: "When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die" (NGSS Lead States, 2013, p. 44).

ESS3.C Human Impacts on Earth Systems. *Grades 3-5*: "Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments" (NGSS Lead States, 2013, p. 47)

5. Mark or show camera locations on the map (5 minutes)

Begin the activity by orienting students to the map, asking them questions to identify and locate landmarks such as the school, lakes, and highways. Use a pin or marker to add the location of the remote camera(s) within the context of what students identify on the map ("the camera was placed at the edge of a forest, which is here on the map").

If students attended the fall visit, use this activity to ask students to share what they remember about setting up the cameras. Suggested questions:

- What is the area like at the location of the field cameras?
- What did you think we'd find?

6. **Share photos from field cameras (15 minutes)**

Encourage students' interest and questions while looking at the photos. Zoo staff will identify the animal(s) in each photo ahead of time, but ask clarifying questions and encourage students to explain their thoughts to uncover prior knowledge.

Phenomenon

Field camera photos and personal encounters with carnivores: Connecting observable phenomena to student interests puts science learning into a relatable context and invests students in their investigations. Encounters with carnivores are common in the Issaquah-Sammamish area. Students may have cameras on their front doors, or your school may have experienced a "lockdown" due to the presence of a black bear on grounds.

7. **Introduce Community Interview homework or Carnivore Spotter (5 minutes)**

Option A: Create a Carnivore Map. Introduce the Community Interview Homework in the **Student Packet**, and explain that students will interview an adult in their household about their sighting of a focal carnivore species. Students will add these sightings, along with their own sightings, as data points on their community map.

Option B: Use Carnivore Spotter. Bring up Carnivore Spotter on the computer screen and describe the process for how people can fill out sightings using the program.

DAY TWO: ADD SIGHTINGS TO MAP

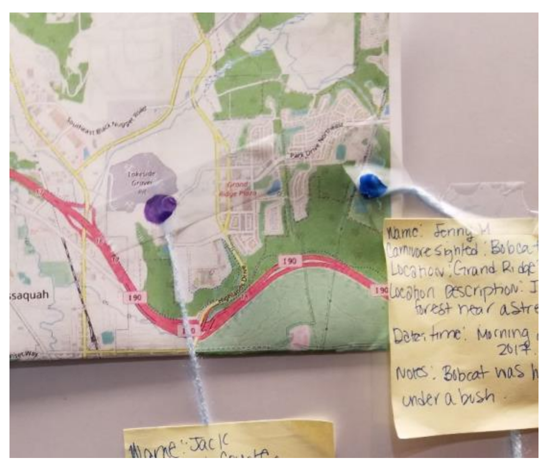
We encourage Option A (student-created map) because students will likely have more ownership of the project if they create a map from their own sightings. However, if time is limited, we recommend using Option B (Carnivore Spotter) because there are fewer images to add.

8. **Students add the sightings/photos to the map/Carnivore Spotter (15 minutes)**

Option A: Create a Carnivore Map. Students fill out a card for the map based on their interviews. Hang the cards next to the map with a string connecting the cards to the approximate location of the sighting on the map or add pins to your digital map. They only need to fill out the following information:

- Student name
- Type of carnivore
- Date and time (approximate)

Option B: Use Carnivore Spotter. Create entries on Carnivore Spotter for the field camera photos and upload the photos to the map (at least one photo per camera).



Scientific and Engineering Practices

Analyze and Interpret Data: "*Use graphical displays (e.g. maps) … to identify temporal and spatial relationships*."

Analysis reveals patterns and cause-and-effect relationships between humans, ecosystem resources and where carnivores are seen.

9. Students identify and record patterns from map (10 minutes)

Review possible patterns on the map (student-created or Carnivore Spotter), especially where carnivore sightings are high or low. Students You can prompt students to think about what might cause those patterns in order to think about "what do humans and carnivores need?"

Crosscutting Concepts

Patterns. "*Graphs, charts, and images can be used to identify patterns in data*."

Visualizing data through graphs, charts, and images can be especially useful for humans to identify patterns. The revised Student Packet assists in assessing student work by making student thinking more visible to themselves and also teachers and program evaluators.

Suggested questions to ask the class:

- Where were carnivores sighted on this map?
- Where are humans living on this map?
- *Why* do you think carnivores were spotted more in this area?
- *Why* do you think carnivores were *not* spotted in other areas?
- What do humans and carnivores need to survive?

In their **Student Packet**, students draw patterns from their map, labeling relevant resources that may influence patterns of where carnivores are seen.

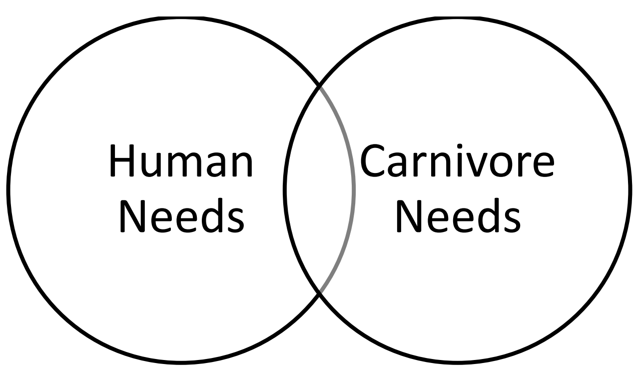
Disciplinary Core Ideas

LS2.A: Interdependent relationship in ecosystems: "*Organisms and populations are dependent on their environmental interactions with both other living things and non-living factors*…"

Be sure to prompt students to think about natural *and* designed resources, including non-living things (water, air, buildings, roads, etc.) and living things (plants, other animals, humans, and even fungi or microbes).

10. Students create a model of what humans and carnivores need (20 minutes)

Use the previous discussion to help students get started on creating a model in their **Student Packets**. The framework for the model is a simple Venn diagram in which human needs and carnivore needs are represented by two circles that overlap (see Figure below).



In this part of the activity, students can be prompted to move from macroscale resources to other needs that people or carnivores may need that aren't visible on the map (e.g., humans need social interaction, carnivores need space away from humans).

In Element 3, students will generate questions from the overlapping area to address the unit's driving question of peaceful coexistence—in which "humans meet our own needs while also allowing carnivores to meet their needs."

Scientific and Engineering Practices

Developing and Using Models: "*Develop and/or use a model to … describe phenomena*."

Diagrams and flowcharts are visual mental models that help make student's thinking visible. Models can reveal what students already know and don't know.

11. Introduce Coexisting with Carnivores and the zoo visit (5 minutes)

Using the provided PowerPoint (www.zoo.org/wwcwc), explain that students will be investigating carnivores in their local ecosystem (including urban and suburban ecosystems) through this driving question:

> **"How can humans peacefully coexist with carnivores—meeting our own needs while also allowing carnivores to meet *their* needs?"**

ELEMENT 2

ZOO VISIT

Student Driving Question: Why are carnivores important?

SUMMARY

Who: Zoo-facilitated

When: Mid-March (for exact date, see Calendar 2019-2020 on page 5)

Time: 1 day (school field trip)

Where: Woodland Park Zoo

DESCRIPTION

During this trip to the zoo, students begin to explore carnivores and local ecosystems. Zoo staff present an overview of the ecosystems of Washington state and research on local carnivores by zoo staff. Students tour the Living Northwest exhibit (with grizzly bears and wolves) and learn about the importance of carnivores in ecosystems.

SCHEDULE

Table 3. A basic schedule of the zoo visit. Your exact Leave Zoo time may be different depending on what you arrange with your bus drivers.

Time	Activity		
9:30 AM	Arrive at Woodland Park Zoo		
9:30 - 9:50 AM	Check-in and Restrooms		
	Group A	**Group B**	**Group C**
10:00 - 10:50 AM	Tour at Living Northwest	Lunch and Zoo Exploration	Wild Wise in Education Center
11:00 - 11:50 AM	Lunch and Zoo Exploration	Wild Wise in Education Center	Tour at Living Northwest
12:00 - 12:50 PM	Wild Wise in Education Center	Tour at Living Northwest	Lunch and Zoo Exploration
1:00 PM	Leave Zoo		

OBJECTIVES

By the end of this element, students will be able to…

- Ask questions to develop their understanding of the effects of carnivores on ecosystems.
- Learn about the life history of Pacific Northwest carnivores and explore conservation topics relevant to carnivores in their community.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Ask questions and define problems

Crosscutting Concepts

- Systems and system models

- Stability and change

Disciplinary Core Ideas

- LS2.A: Interdependent relationships in ecosystems
- LS2.C: Ecosystem dynamics, functioning, and resilience
- ESS3.C: Human impacts

MATERIALS AND PREPARATION

- ❑ **6 weeks or more before**: Arrange bus transportation with building bookkeeper. Contact ISD Curriculum Specialist with questions (Contacts, p. 4)
- ❑ Divide all students and chaperones into 3 equal-sized groups: A, B, C. (Optional: Write on student nametags).
- ❑ Make arrangements for accessibility, if needed (zoo.org/access)
- ❑ The Lead Teacher prints and **brings the following materials** on the day of visit:
  - ❑ **Registration Confirmation Form** (attached to confirmation email from schools@zoo.org) with accurate day-of numbers of students and adults (including teachers, chaperones, and aides)
  - ❑ Copies of the **School Field Trip Map and Guide** for each adult (zoo.org/maps or attached to email from schools@zoo.org)
  - ❑ Copies of the **Zoo Schedule** for each adult (below, or in email from Lead Learning Facilitator)
  - ❑ **Purchase Order** or other method of payment

ACTIVITIES

The **Student Packet** contains a sheet for students to reflect on their zoo visit experience. Students can bring the worksheet to make notes while at the zoo, or fill it out as a reflection after they return to.

During and after the visit, students are encouraged to ask questions about carnivores, ecosystems, and scientific research.

> **Scientific and Engineering Practices**
>
> **Ask questions and define problems**: "*Ask questions … to clarify and/or seek additional information*."
>
> Encourage students to ask questions throughout the unit and the zoo visit. Asking questions is an important skill to learn as part of science inquiry and learning, and questions are also a sign of engagement.

1. Arrive at the zoo's South Entrance (9:30 AM)

Busses will drop students off in the Hippo Lot (50th and Fremont). We recommend chaperones ride with students on the buses because they must enter the zoo with their student groups via the South Entrance.

Students, teachers and chaperones unload from buses immediately and gather into their A, B, or C Group (zoo staff will have signs). Due to space restrictions and safety in the parking lots, we cannot hold students on buses.

2. Check in and use restrooms (30 minutes)

The Lead Teacher (with paperwork) checks in with the zoo staff by providing a Purchase Order, and day-of counts of students and adults.

Depending on their Group (A, B or C), chaperone groups will go to different parts of the zoo for their first activity.

3. Tour Living Northwest (50 minutes)

Meet at the entrance to the Living Northwest (formerly Northern Trail) at the Northeast area of the zoo. Students will be split into about four even groups, each led by a different Wild Wise Instructor. At four stops along the tour, students learn about:

- The story of wolves in Yellowstone and how they changed the rivers
- Life history of some carnivores in the Pacific Northwest
- Role of carnivores in ecosystems

Disciplinary Core Ideas

LS2.A: Interdependent relationships in ecosystems: "…*Competitive, predatory, and mutually beneficial interactions vary across ecosystems, but the patterns are shared*."

LS2.C: Ecosystem dynamics, functioning, and resilience: "*Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations*…"

Carnivores have interdependent relationships to living things in our ecosystems, including humans and other animals, and plants.

Crosscutting Concepts

Systems and system models: "*Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy [and] matter … flows within systems*."

Ecosystems can be modeled through diagrams and flow charts that show how energy and matter flow through trophic levels. Through these diagrams, students can understand how carnivores can not only affect prey species, but plant species and landscapes as well.

Stability and change: "*Small changes in one part of a system might cause large changes in another part*."

A memorable example of this is how reintroducing wolves changed the rivers of Yellowstone. This concept can be reinforced through videos such as this one by Sustainable Human: https://www.youtube.com/watch?v=ysa5OBhXz-Q

4. Eat lunch and explore the zoo (50 minutes)

Students will bring and transport their own lunches; the zoo cannot store lunches. Areas convenient for students to eat their lunches are marked on the School Field Trip Map and Guide.

Chaperone groups can also explore any area of the zoo EXCEPT Zoomazium (indoor family play area for children 8 and younger) or Willawong Station (feeding Australian parrots) due to crowds and safety.

At the end of the program in June, each participating student will receive a ticket to attend the zoo with up to three other people. Therefore, if students do not get to see what they want to during the field trip, they can return later.

5. Go to Wild Wise presentation at the Education Center (50 minutes)

Zoo staff lead students in an interactive, multimedia presentation that focuses on using naturalist skills with local carnivores. Topics include:

- Short history of ecosystems in Issaquah-Sammamish area
- Example research projects at the zoo (Seattle Urban Carnivore Project) as models for students' investigations
- How scientists (including students) can study carnivores: Field cameras, carnivore signs and tracking

Disciplinary Core Ideas

ESS3.C: Human impacts*: "Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things…"*

Humans can have negative effects on the environment, such as through habitat loss, and they can also have positive or neutral effects on the environment, such as by consciously altering our behaviors or performing research.

6. **Load onto buses and leave the zoo (1:00 PM)**

   The departure time is approximate and determined by your bus service, not the zoo. If you have arranged a different departure time with your bus service, please notify the zoo's Lead Learning Facilitator.

ELEMENT 3

INVESTIGATIVE QUESTION

Student Driving Question: How do humans impact carnivores?

SUMMARY

Who: Zoo- and/or Teacher-facilitated

When: Mid- to late March (for exact date, see Calendar 2019-2020 on page 5)

Time: 2 periods

Where: Classroom

DESCRIPTION

Students develop an investigative question and prediction related to the driving question of the unit—how can humans meet our needs while allowing carnivores to meet their needs? Students draw upon the carnivore community map to create questions with cause-and-effect relationships. Teachers help students define variables that are testable. Next, students create a prediction graph to assist with their data analysis later. Finally, students write a reflection on the connection between their investigative question and the unit's driving question to use later when they build their recommendation.

OBJECTIVES

By the end of this element, students will be able to…

- Collaboratively develop a testable investigative question to explore the cause-and-effect relationship between carnivores, humans, and resources they need to survive.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Ask Questions and Define Problems (x3)
- Using Mathematics and Computational Thinking

Crosscutting Concepts

- Patterns
- Cause and Effect

Disciplinary Core Ideas

- LS2.A: Interdependent relationship in ecosystems
- ESS3.C: Human impacts

MATERIALS AND PREPARATION

- ❑ Review Element 4: Methods—it is easier to help shape the question if you know what methods are available
- ❑ Distribute Student Packets sheet (E3: Investigative Question)

ACTIVITIES

1. Introduce the activity of creating an investigative question (5 minutes)

Ask students to recall the driving question of the unit: “How can humans and carnivores peacefully coexist—meet our needs while also allowing carnivores to meet their needs?”

Tell students they will be creating an investigative question today. Ask students: What makes a good investigative question? Guide suggestions from students so they understand that questions should be:

- On topic: Questions should be related to the driving question (about carnivores and their needs)
- Testable: Questions should be testable with the resources available to them
- Specific: The variables need to be specific so they can be measured

These points set the stage for the next several steps as students develop their question.

Disciplinary Core Ideas

LS2.A: Interdependent relationship in ecosystems: “*Organisms and populations are dependent on their environmental interactions with both other living things and non-living factors*…”

ESS3.C: Human impacts: “*Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things*…”

To keep students on track, reinforce the goals of the unit incorporating interdependent relationships between human, carnivores, other animals and plants and/or components of the ecosystem.

2. Students brainstorm questions in small groups (5 minutes)

Ask students to look back at the patterns they identified and included in the Venn diagram they created in **Element 1**. Students record brainstorm questions in their **Student Packet**.

While students are brainstorming questions and writing them down, walk around the room to identify key topics.

Crosscutting Concepts

Patterns: “*Patterns can be used to identify cause and effect relationships*.”

Students identify patterns from their map and think about what humans and/or carnivores need as possible causes for those patterns.

3. Students adjust questions to incorporate cause and effect (5 minutes)

Next, introduce students to a cause-and-effect relationship. Write the basic template on the board:

Does/Do __________ cause/affect __________?

Share some examples of initial questions and how they can be adjusted to incorporate Cause and Effect:

- *Do raccoons like trash? → Do outdoor trash cans at night **cause** carnivores to disturb trash?*
- *Is it good or bad to bring pets on a hike? → Do pets on hikes **affect** the number of carnivores encountered?*
- *Do carnivores avoid roads? → Does distance from a road **affect** how many carnivores are seen?*

Students modify their questions to incorporate cause and effect in their **Student Packet**. Depending on your students’ experience, they may need additional scaffolding and support. You can do some examples on the board for the whole class in the next step.

Crosscutting Concepts

Cause and Effect: "*Phenomena may have more than one cause*…"

Observations of carnivore sightings can have several causes: natural resources (water, food), designed resources (buildings, roads), and humans. Students' investigative questions will be looking at one of these possible causes to test if that relationship is the strongest (if that cause has the largest effect).

4. Class compiles cause-and-effect questions and choses the investigative question (10-20 minutes)

Ask students to share out their favorite questions to the whole class and write them on the board. **Only write down questions that have a cause and effect relationship.** If students offer a question that does not have a cause and effect relationship, use it as a teachable moment and help them tweak the question.

Students may struggle to grasp the concept of cause and effect, but it is a key crosscutting concept of science learning and it is worthwhile to spend time on it. You may need to ask students to go back to their small groups or incorporate more explicit teaching as a whole class if they are struggling.

Help students chose one question to investigate. You may need to combine questions surrounding a similar topic into one testable question, or ask the class to vote anonymously by lowering their heads and raising their hands.

Students record their **investigative question** in their **Student Packets**.

Scientific and Engineering Practices

Ask Questions and Define Problems: "A*sk questions that require sufficient and appropriate empirical evidence to answer*"

Remind students that they will be the ones collecting evidence to answer their question and making a recommendation to the community. So, the topic should be something they are interested in engaging with for the next few months.

5. Students reflect on how their question is relevant to the driving question of the unit (5 minutes)

Come back once again to the driving question of the unit: How can humans and carnivores coexist peacefully?

In their **Student Packets**, students reflect by answering the question: "I think this question will help humans and carnivores coexist peacefully because…." For example, questions about trash may help humans dispose of their trash while allowing carnivores to be healthy (by not eating trash or becoming dependent on humans).

Students can use this reflection when writing their reasoning for their recommendation in Element 6. It can also help students stay connected to their motivation for choosing this investigative question during the investigation process.

6. Identify the question's independent (manipulated) and dependent (responding) variables (5 minutes)

Write down the investigative question and label the independent and dependent variables. In a cause-and-effect relationship, the basic format is

- *Does the independent variable* ***cause/affect*** *the dependent variable*?
- *Does the manipulated variable* ***cause/affect*** *the responding variable*?

Some examples of independent and dependent variables follow:

- *Does leaving trash cans out at night* ***cause*** *carnivores to disturb trash*?
- *Do pets on hikes* ***affect*** *the number of carnivores encountered?*
- *Does distance from a road* ***affect*** *how many carnivores are seen*?

Scientific and Engineering Practices

Ask Questions and Define Problems: "*Ask questions to determine relationships between independent and dependent variables*"

Planning and carrying out investigations: "*Plan an investigation … collaboratively, and in the design identify independent and dependent variables and controls*."

Clearly defining the independent (manipulated) and dependent (responding) variables in the question helps make connections to cause and effect easier when students create their recommendations and explanations.

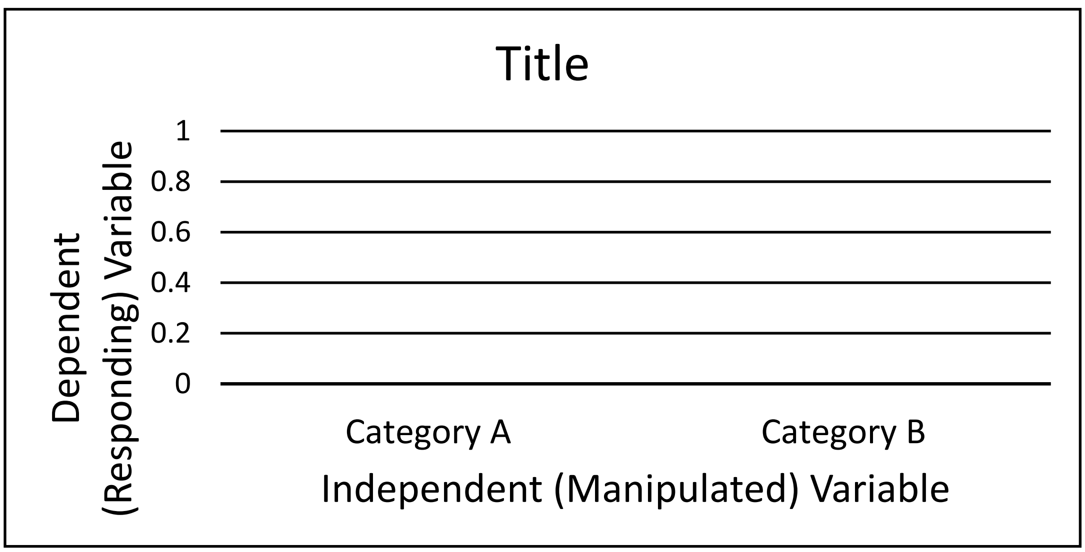
7. **Start creating a prediction graph (5 minutes)**

Next, students start creating a graph in their **Student Packets** to help them visualize and refine the variables and make a prediction. You can do this in whichever order you like—here, we create a blank prediction graph and fill it in as students refine their variables.

To make a prediction graph, draw a square on the board. Over the next several steps, students will fill in the parts of the graph as follows:

- Independent/Manipulated variable = X-axis
- Dependent/Responding variable = Y-axis
- Predicted outcome = bars in graph and title

Figure 1: Blank, generic prediction graph with a space for the title, dependent/responding variable, independent/manipulated variable with two categories.



8. **Refine the Independent/Manipulated Variable (5 minutes)**

Ask students, "Where will you **find** the conditions you want to study?" For this project, students need to examine **existing conditions** that are testable. They **cannot modify or manipulate the environment.**; This is unethical due to the risk of harming carnivores, people and/or property. (This can be especially confusing if you use the term "manipulated variable" instead of "independent variable").

For example, if students are examining the condition of leaving <u>trash out at night</u>:

- **Not testable**: Put out trash and see how many carnivores are attracted
- **Testable**: Survey neighborhoods with LOW and HIGH numbers of trash cans left out

Note that the independent variable (x-axis) should have two or more categories. Categories aid in creating bar graphs and the "cut off" can be determined by students ("Low Trash" is less than half of houses put out trash the night before, "High Trash" is more than half of houses with trash cans out). This can be discussed in the next step.

Students record the refined independent (manipulated) variable on their prediction graph in their **Student Packet**.

Scientific and Engineering Practices

Ask Questions and Define Problems: "*Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilitates with available resources*…"

The scope of a question can be hard to gauge unless you are familiar with the available research methods. Because students will not be familiar with these yet, it is important for the facilitator to be familiar with the methods (see Element 4) to help guide students.

9. Refine the Dependent/Responding Variable (5-10 minutes)

Ask students *what* will they measure—they will determine *how* to measure it in the next Element, but it is good to know what the options are so you know the students will be able to measure it. Most often, the variable is:

- Number of carnivores

Students can also be creative in their measurements, depending on the question. For example, the dependent variable of "Do outdoor trash cans at night cause carnivores to disturb the trash?" can be measured by:

- Percentage of trash cans in neighborhood knocked over in the morning

What students measure may depend on **how** they want to collect the data, so you should be already familiar with the types of methods available (see Element 4).

Students record the refined dependent (responding) variable on their prediction graph in their **Student Packet**.

Scientific and Engineering Practices

Using Mathematics and Computational Thinking: "*Apply mathematical concepts and/or processes (e.g., ratio, rate, percent…) to scientific … questions*..."

Depending on the variable, it may be useful for students to record percentages. For example, with the trash cans, students can count the number of trash cans knocked over. However, just counting raw numbers of trash cans knocked over will not control for the size of the neighborhood (larger neighborhoods or streets with more trash cans may have higher numbers of cans disturbed than smaller neighborhoods). You may introduce concepts such as percentages in cases such as this.

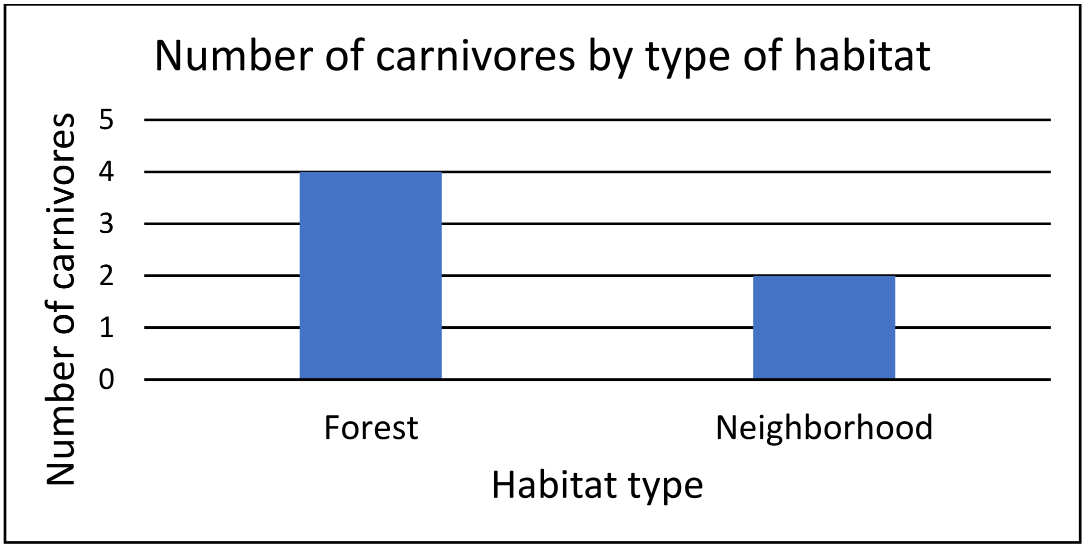
10. Students make a prediction (5 minutes)

In their **Student Packets**, students add the bars into their prediction graph and write their prediction in the form of a sentence. Even if a class has the same investigative questions, student groups can have different predictions. See Below is an example of a completed prediction graph.

11. Send investigative questions to zoo staff (after class)

Email the investigative questions to wild.wise@zoo.org so zoo staff can keep track and prepare for future elements.

Figure 2: Example of a prediction graph for an investigative question like "How does habitat type affect the number of carnivores?"



ELEMENT 4

METHODS AND DATA COLLECTION

Student Driving Question: What is the most appropriate way to collect data for my investigation?

SUMMARY

Who: Teacher- or zoo-facilitated

When: Late March, data collection through April (for exact date, see Calendar 2019-2020 on page 5)

Time: 1-3 periods, depending on method(s)

Where: Classroom

DESCRIPTION

Students explore and choose the research methods they will use to gather data related to their investigative question. Using their refined variables, students explore different options for collecting data including field cameras, online or in-person surveys, existing sources of data (such as the zoo's Carnivore Spotter), and/or field research. Depending on the method, more time may be spent refining the research area, survey questions, etc. Students create a plan for data collection and carry it out over 3 to 4 weeks.

OBJECTIVES

By the end of this element, students will be able to…

- Evaluate the benefits and limitations of multiple research methods to select methods appropriate to their investigative question**.**
- Collect data to address their claim about the relationship between carnivores and a component of interest.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Plan and Carry Out Investigations (x4)

MATERIALS AND PREPARATION

- ❑ Review Methods available to students (Table 4 on page 32)
- ❑ Distribute Student Packet sheets (E4: Methods and Data)

ACTIVITIES

1. **Review the investigative question and variables (5 minutes)**

   Ask students what their question was and record it on the board. Ask students to state what their independent and dependent variables are for their investigative question.

   Next, tell students that they will determine HOW to measure the variables to get the information needed to answer their question.

Scientific and Engineering Practices

Planning and carrying out investigations: "*Plan an investigation … collaboratively, and in the design identify…what tools are needed to do the gathering, [and] how measurements will be recorded"*

Planning and carrying out investigations: *"Conduct an investigation … to produce data to serve as the basis for evidence that meet the goals of the investigation*."

It's important that students are on the same page when they are collecting data in a careful and methodical way, so all their data can accurately and effectively answer their question.

2. **Brainstorm methods and create a pro/cons table to choose method(s) (20-30 minutes)**

   In this activity, you will help the students brainstorm methods and consider the pros and cons of each method. As a preview, we have provided Table 4 on page 32 as an example of the most common methods and responses that students give for pros and cons.

   Students record the pros and cons in their **Student Packet** in small groups or as a class. Ask students to brainstorm methods and write them in the first column. You can ask guiding questions to help students consider all of the methods available to them—or other methods we have not included here.

   Then continue to fill out the pros and cons for each method.

   Tell students that within the constraints of the investigation, they will need to just choose one or two methods. To help them pick the best method for their question, they will consider the advantages and disadvantages of each type of method.

Scientific and Engineering Practices

Planning and carrying out investigations: "*Evaluate the accuracy of various methods for collecting data*."

Creating a pros/cons list may take some time, but it's a valuable practice for students to think critically about data collection, accuracy and what they are interested in doing.

3. **Students vote and choose their method(s) (5 minutes)**

   To narrow down the options, ask students to vote anonymously by lowering their heads and raising their hands. Remember that more than one methods can be selected. For example, some students can choose camera traps and other students can do walking surveys. Students put a star in their **Student Packet** next to the methods the class chooses.

4. **Plan for collecting data (15-30 minutes)**

   Facilitate a discussion with students on the general steps they will follow to collect data. The suggestions provided in Table 5 on page 33 are a general resource and guide. Encourage students to enough detail for another class (or researcher) to reproduce the experiment. Students can also add pages to their Packets as needed (such as survey questions).

   Students record the materials, supplies, and procedure they will follow to collect data in their **Student Packets**.

Scientific and Engineering Practices

Planning and carrying out investigations: "*Collect data to produce data to serve as the basis for evidence to answer scientific questions*…"

Data collection takes time but is an important scientific practice, especially when students are doing it to answer their own investigative question.

Table 4. A list of suggested methods for this unit and example pros and cons that students may suggest.

Method	Advantages (Pros)	Disadvantages (Cons)
Online survey questions Students create online survey questions and disseminate them via various methods (see Appendix D: Online survey resources)	Can collect data from many people quickly (efficient) Survey program has data analysis features which can be helpful in reviewing results	Survey may get distributed to people outside of interest area (Issaquah-Sammamish) People may "lie" or not remember sightings accurately
In-person Interviews Students conduct short, in-person interviews with community members (see Appendix F: Develop Survey Questions)	Can clarify and ask follow-up questions (people "less likely to lie") Can collect data in settings of interest (e.g. particular neighborhoods or on trails)	Takes more time than online surveys Need to talk to people in person
Review existing data Students use existing data such Carnivore Spotter or published papers about Washington carnivores (see Appendix E: Existing Data on Carnivores)	Data is already collected, which can save time	Large sets of data may be tedious to filter and sort May be challenging to find data relevant to question
Field cameras Students install motion-activated cameras that photograph animals	Reliable first-hand evidence Recent and timely data Fun and exciting	Not a lot of time to collect new data Need permission from land owner It can take time to sort through all photos
Digital Maps Students analyze maps to identify areas of interest and summarize carnivore sightings within the area	Suitable for spatial data, such as comparing Can collect data from many people quickly (efficient)	People may not remember sightings accurately or may lie People may not follow directions, and leave out information
"Walking Survey" or Transect Students can walk (or an adult can drive them) through areas to record signs of carnivores or other features of interest	Collect indirect evidence of carnivores via sightings of scat, tracks and other signs Fun and exciting	Takes time to conduct Identification of species and time can be difficult

Table 5. General process of data collection for the most common methods available to students. For more information or tips, refer to the appropriate Appendix or contact zoo staff for guidance on other possible methods.

Method	General Process of Collecting Data
Online survey questions	1. Draft survey questions based on investigative question. An activity for drafting survey questions is available in Appendix [REF]. 2. Create the survey. A list of online survey tools that students can use is available in Appendix [REF]. If you prefer, you can also send the students' questions to zoo staff and we will create a survey and send you the link. 3. Discuss how students will disseminate their questions. How can they get the most results that are valid and unbiased (random)? 4. Publish survey(s) and determine date at which the survey will be stopped and results examined.
Review existing data	1. Review sources to select which may be appropriate based on the investigative question. For a list of possible resources, see Appendix [REF] 2. Depending on how large the data set is, the class can determine how to divide the data sets or examine multiple data sets. Students may need to create conditions by which to filter data (observations within the last year, observations of only one to two types of carnivores instead of all of them). 3. If possible, students can export the subset of data they are interested in.
Field cameras	1. Class determines the characteristics for the sites where field cameras will be installed. 2. Identify locations and obtain permission for sites (from public lands or private houses). Zoo staff can help you obtain permission from City of Issaquah parks. 3. Find specific instructions for installing field cameras in Appendix [REF].
In-person interviews	1. Draft survey questions (you can send to zoo staff for feedback) based on investigative question. An activity for creating survey questions is in Appendix [REF]. 2. Discuss how students will find people to interview and what the protocol will be. For the best results, try obtain a random sample.
Maps (including Carnivore Spotter)	• **In a survey**: Maps are commonly used in conjunction with an online survey. Appendix [REF] has instructions on how to make a digital map and share it with participants via a link in the survey. • **To define areas of interest**: Maps can be used to define areas according to the categories of independent/manipulated variable (e.g., old vs. new neighborhoods). For a list of maps in the Issaquah-Sammamish area, see Appendix [REF]. You may want to print out large copies of a particular map for students to have on hand as they analyze data.
"Walking Survey" or Transect	1. Students use a map to identify areas where they could examine a feature of interest (choose at least one area in each condition of their manipulated variable, if applicable). 2. Students develop a data sheet and agree on what they will be recorded (see REF table for a suggested generic table format). 3. Give field guides in your Coexisting with Carnivores kit to students for reference.

ELEMENT 5
DATA ANALYSIS
Student Driving Question: What story does my data tell me?

SUMMARY

Who: Zoo- or Teacher-facilitated

When: Late April to early May (for exact date, see Calendar 2019-2020 on page 5)

Time: 1 to 3 periods

Where: Classroom

DESCRIPTION

Students compile and summarize their raw data, using their prediction graph from Element 3 as a guide. Students analyze their results, consider confounding factors, and interpret their results to answer the investigative question.

OBJECTIVES

By the end of this element, students will be able to…

- Analyze and interpret data to identify the relationship between carnivores and resource of interest.
- Analyze and interpret maps (as appropriate) of carnivore sightings to identify relationships between carnivores and a resource of interest.
- Use appropriate statistical measures (e.g. mean, median, and mode) to analyze data.
- Construct graphical displays of data to demonstrate their findings about the relationship between their chosen independent/manipulated and dependent/responsive variables.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Ask Questions and Define Problems (x2)
- Analyze and Interpret Data (x5)
- Use Mathematics and Computational Thinking (x2)

Crosscutting Concepts

- Patterns (x2)

MATERIALS AND PREPARATION

- ❑ See Table 6 on page 35 for initial steps that may need to be completed before beginning activities
- ❑ Distribute Student Packet sheets (E5: Data Analysis)
- ❑ Ask students to bring their data (online maps, online survey, field camera photos, person-to-person interview data)
- ❑ Arrange computer access for small student groups to explore data (optional)

ACTIVITIES

During this process, it may be helpful if students work in small groups through each step and then contribute to whole-class discussions. Depending on the students' methods, the analysis will be a little different. Refer to the table below for method-specific analysis steps that may need to be completed before or in addition to the Activity steps.

For questions that rely on geographical information (distance to road, streams, age of neighborhood, etc.): It may be useful to access maps from the city or King County. See Appendix for list of resources.

Table 6. Suggested processes for analyzing data based on the method(s) selected by students. Use these additional steps as needed and in conjunction with the lesson activities.

Method	Suggested General Data Analysis Process
Online survey questions	1. On the decided date, stop the survey collector. This ensures that additional data will not change your results if you need multiple days for data analysis. 2. Export the data into your preferred digital spreadsheet such as Google Sheets or Excel, see Appendix D: Online survey resources for the different online surveys and options for exporting data. SurveyMonkey analyzes results for you; see Appendix G: SurveyMonkey Data Analysis for guidance. 3. Follow the activity for general steps on creating a graph and analyzing results.
Review Existing Data	If students are able to print or export the data, follow the general steps of the activity to analyze the results with your preferred method of visualization (paper or digital).
Field cameras	1. Sort through photos to identify and count carnivores. Groups of photos can be divided amongst student groups to reduce the time to sort through photos. Alternatively, you can pull out the photos of animals into a subset for students to review. 2. The whole class compiles their counts of carnivore sightings into a table.
In-person interviews	1. Same as online surveys, although you may want students to enter their data from paper into a digital spreadsheet. You may ask students to do this as they collect the data instead of during analysis. Entering data as they go also helps prevent data loss. 2. Follow the rest of the activity for general data analysis process.
Digital Maps (including Carnivore Spotter)	1. If it hasn't been done, identify spatial areas of interest according to the independent/manipulated variable categories (e.g. areas close to vs. far from roads, old vs new neighborhoods). 2. Count sightings within each area. Students can split into small groups to look at different areas of the map to review the data. More details in Appendix H: Analyzing Digital Map Data 3. The whole class compiles the results into a single table.
"Walking Survey" or Transect Observations	1. Ask students to enter their data from paper into a digital spreadsheet. They can also do this as they collect the data instead during analysis. Entering data as they go also helps prevent data loss. 2. Follow the rest of the activity for general data analysis process.

1. **Review the class investigative question and prediction graphs (5 minutes)**

   Ask students to pull up the prediction graph from Element 3. Review the independent/manipulated and dependent/responding variables, the categories, and student predictions.

   Tell students that today that are going to be making a graph of their results and comparing it to their prediction graph.

You may want to frame these activities as a messy, but important, part of the scientific process. Sometimes results are unexpected and not as clear as the prediction. Remind students that even if their predictions were "wrong," they can learn a lot from "negative" results. In fact, sometimes unexpected findings are the most interesting ones!

Scientific and Engineering Practices

Using Mathematics and Computational Thinking: "*Use digital tools (e.g. computers) to analyze very large data sets for patterns and trends*."

Using digital tools such as Survey Monkey or Carnivore Spotter to filter results can help students analyze large amounts of data quickly.

2. **As needed, compile raw data into a table (5 to 20 minutes)**

   Students can record their data in a shared digital spreadsheet or write their data on the board—just make sure that the compiled data is easily accessible to everyone.

   Students record the table into their **Student Packets** (there is extra room for mistakes or multiple iterations).

Table 7. Suggested table for organizing raw data. Each row can be an individual observation or total from a group or area. Note that each row might not contain data in every cell.

Observations of Dependent/Responding Variable from…	Category A of Independent/Manipulated Variable	Category B of Independent/Manipulated Variable
Group 1		
Group 2		
Group 3		
Group 4		
TOTAL (sum)		

3. **As needed, summarize the raw data using statistics (5 minutes)**

   Encourage students to use percentages and/or simple statistics such as mean (average), median, or mode to quantify and summarize the data. See Appendix A for definitions of these types of statistics.

Scientific and Engineering Practices

Analyzing and Interpreting Data: "*Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible*."

Using Mathematics and Computational Thinking: "*Apply mathematical concepts and/or processes (e.g. ratio, rate, percent …) to scientific … questions*."

4. **Students create a graph or visualization of their data (5 minutes)**

   Using the prediction graph as a template, students create a graph of their results in their **Student Packet**.

Scientific and Engineering Practices

Analyzing and Interpreting Data: "*Construct, analyze, and/or interpret graphical displays of data*"

Analyzing and Interpreting Data: "*Use graphical displays (e.g. maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships*."

Crosscutting Concepts

Patterns: "*Graphs, charts, and images can be used to identify patterns in data*."

Visualizing data is one of the most useful steps in analyzing data. It makes patterns clearer and easier to interpret.

5. Discuss and interpret the results (10 minutes)

It may help to frame this discussion starting from overall trends before moving to details. Ask students:

- What are the general patterns seen in the graph?
- How is the results graph different or similar to the prediction graph? Why do you think that is?
- Is there anything you didn't expect? Why might that have happened?
- What new questions do you have based on your results?
- If you were to do this investigation again, what might you change?

Students record the answers to these questions, their interpretation, and unexpected results in their **Student Packet**.

Scientific and Engineering Practices

Asking Questions and Defining Problems: "*Ask questions that arise from…unexpected results*."

Asking Questions and Defining Problems: "*Ask questions that challenge … the interpretation of a data set*."

Analyzing and Interpreting Data: "*Distinguish between causal and correlational relationships in data*."

Crosscutting Concepts

Patterns: "*Patterns can be used to identify cause and effect relationships*."

6. Students consider confounding factors and future investigations (10 minutes)

Ask students to think about confounding factor, which may have been discussed during Element 4 (Methods). Confounding factors are anything outside the control of the students that may affect the results, including measurement error, small sample size, confusion on behalf of the participants of a survey, or unusual weather.

If students feel like they "failed," frame this discussion as a learning opportunity. It may take scientists many tries to learn and adapt their experiments.

Scientific and Engineering Practices

Analyzing and Interpreting Data: "*Consider limitations of data analysis (e.g., measurement error)*"

There are always limits to what we can interpret from data. Knowing the limitations help discover new questions, plan better investigations, improve methods, and make better explanations.

ELEMENT 6
RECOMMENDATION AND PRESENTATION BUILDING

Student Driving Question: How can my investigation help people peacefully coexist with carnivores?

SUMMARY

Who: Teacher-facilitated

When: Early to mid-May (for exact date, see Calendar 2019-2020 on page 5)

Time: 2 or more periods

Where: Classroom

DESCRIPTION

Students develop their recommendation for how their community can peacefully coexist with carnivores, using the Claim-Evidence-Reasoning (CER) framework of a scientific explanation. The Evidence and Reasoning portions are based on students' investigations. Their presentation is built around their recommendation and can take the form of a slideshow or a tri-fold board.

OBJECTIVES

By the end of this element, students will be able to…

- Develop an explanation for their findings about the relationship between carnivores and a resource of interest from the data they collected.
- Discuss the limitations of their data collection and analysis, including confounding factors.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Ask Questions and Define Problems
- Construct Explanations and Design Solutions (x4)

Crosscutting Concepts

- Stability and Change

Disciplinary Core Ideas

- LS2.A: Interdependent relationship in ecosystems
- LS2.C: Ecosystem dynamics, functioning, and resilience
- ESS3.C: Human impacts on Earth systems

MATERIALS AND PREPARATION

Part 1: Recommendation Building

- ❑ Distribute Student Packet sheets (E7: Recommendation Building)

Part 2: Presentation Building

- ❑ Distribute Student Packet sheets (E7: Presentation Building)
- ❑ Arrange for computer access (if preparing projects on computers)
- ❑ Order poster boards from zoo (if students are preparing trifold poster boards)
- ❑ Obtain pens, colored pencils, and art supplies as needed for student projects
- ❑ Determine the format of Communication Tools (see Table 8 on page 42)

ACTIVITIES

PART 1: RECOMMENDATION BUILDING

It may be helpful for students to work in small groups to create their recommendations.

1. Introduce the activity and revisit students' motivations (5 minutes)

Frame the introduction to this element as taking a step back to look at the broader context of research and investigations. Up until this point, students have been focused on looking at a specific investigative question. Now, they will be developing a scientific explanation that puts their results into the context of solving problems in society.

Ask students to review and share what they wrote for their motivation of asking their investigative question in their **Student Packets from Element 3**. This can help set the stage for making connections between their investigation and the recommendation.

If students are unfamiliar with the Claim-Evidence-Reasoning (CER) framework for creating a scientific explanation, you may want to spend a time reviewing each part and/or provide examples of CER explanations.

> **Scientific and Engineering Practices**
>
> **Constructing Explanations**: "*Construct a scientific explanation based on valid and reliable evidence obtained from sources (including students' own experiments*)."
>
> **Constructing Explanations**: "*Apply scientific ideas … and/or evidence to construct, revise … an explanation for real-world phenomena*."

2. Students develop a Claim (10 minutes)

Ask students to recall the driving question of the unit ("How can humans peacefully coexist with carnivores—meet our needs while allowing carnivores to also meet their needs?").

Explain to students that a claim is a statement that answers the investigative question—in this case, the driving question of the unit. It is usually one sentence in length, and does not include any reasoning, evidence, or words like "because." A framework for the claim can be:

In order to peacefully coexist with carnivores, we recommend that people __________.

Examples of recommendation claims are below:

- …be aware of carnivores if you live in an older neighborhood.
- …watch out for carnivores while driving at night.
- …hike in groups.

Students write a Claim in their **Student Packet**.

Disciplinary Core Ideas

ESS3.C. Human Impact on Earth systems. "…*Activities and technologies can be engineered to reduce people's impacts on Earth*."

Changing our behavior or attitudes that impact local carnivores and wildlife is a part of the zoo's mission to "make conservation a priority in everyone's lives."

3. **Students support their Claim with Evidence (10 minutes).**

Explain to students that the evidence for their claim should be based on their investigation results. It can be the major finding of their investigation or a summary of their results graph. Their evidence can begin with a sentence such as:

"When we [used this(ese) method(s)], we found [this major finding]."

The following is evidence from a student project: "When we asked how often people were seeing carnivores in their neighborhoods, we found out that carnivores are sighted more often in older neighborhoods than younger neighborhoods. Neighborhoods that are 21+ years old report being regularly seeing 35% of commonly seeing carnivores. By regularly we mean daily, weekly, or monthly. Only 19% of people living in newer homes (0-5 years) report seeing carnivores regularly."

Students work in small groups to write their evidence to support their claim in their **Student Packet**.

Disciplinary Core Ideas

Constructing Explanations: "*Construct an explanation that includes qualitative or quantitative relationships between variables that … describes phenomena*."

Crosscutting Concepts

Stability and Change: "*Explanations of stability and change in natural … systems can be constructed by examining changes over time*…"

4. **Students connect their Claim and Evidence with Reasoning (15 minutes)**

Reasoning explains "why and how" their evidence supports their claim. It includes an explanation of the underlying science concept that produced the evidence or data. Student reasoning may be based on information they gathered at the zoo, during the Western Wildlife Outreach visit, or their knowledge of ecosystems and how carnivores impact ecosystems.

Reasoning for the example above may be the following: "Older neighborhoods have larger trees and more shrubs and other plants that the carnivores' prey like to eat. Therefore, people in older neighborhoods can expect to encounter more carnivores because the environment is like their native ecosystem."

Students record their reasoning in their **Student Packet**.

Scientific and Engineering Practices

Constructing Explanations: "*Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion*."

Disciplinary Core Ideas

LS2.A: Interdependent relationship in ecosystems: "*Organisms and populations are dependent on their environmental interactions with both other living things and non-living factors, any of which can limit their growth*…"

LS2.C: Ecosystem dynamics, functioning, and resilience: "*Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations*…"

ESS3.C: Human impacts on Earth systems: "*Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different things*…"

Reasoning can emphasis interdependent relationships in ecosystems and/or human impacts related to the DCIs.

5. **Students review each other's recommendations and give feedback (10 minutes)**

   If time allows, ask students to exchange packets to read each other's recommendations and/or read them aloud to the class for feedback.

   - Do you think the reasoning connects the evidence to the claim?
   - Do you think that is the best explanation?

Scientific and Engineering Practices

Asking Questions: "*Ask questions to clarify and/or refine … an explanation*."

Constructing Explanations: "*Construct … an oral and written argument supported by empirical evidence and scientific reasoning to support … an explanation*."

PART 2. PRESENTATION BUILDING

Presentation building has been simplified through the Student Packet, which clearly identifies the components that will be included in the presentation.

6. **Introduce the task of giving a presentation (5 minutes)**

   If you haven't already, tell students that zoo staff will be coming to the classroom to view their presentation. You can tell students that it is our favorite part of the unit because we get to see all the hard work they've been putting into their projects.

   Hand out the Student Checklist. Feel free to add any of your own expectations for good presentations, such as good slide design.

7. **Students develop their Communication Tool and presentation (45 minutes or more)**

   Students complete their communication tools (possible formats in Table 8 on page 42 and practice giving their presentations prior to Element 7. The communication tool will be prepared by students and used to accompany a five-minute presentation about their investigation. The most popular formats are digital slides or tri-fold boards.

   Encourage students to review their work using the Student Checklist and make revisions to their Communication Tool and presentation as needed.

Scientific and Engineering Practices

Constructing Explanations: "*Construct … an oral and written argument supported by empirical evidence and scientific reasoning to support … an explanation*."

Table 8. Various communication tools that students can use to present their recommendation and investigation results. Students must also prepare a five-minute presentation in addition to their Communication Tool.

Format	Description
Presentation Slides	• Create slides using PowerPoint or Google Slides. Students may also use Prezi, a free interactive online presentation tool (https://prezi.com/).
Tri-fold poster	• Use a tri-fold poster to display the recommendation and project elements.
Public Service Announcement (PSA)	• A PSA is designed to reach a specific group with a message that will change their behavior. • For a PSA lesson plan, including a template and rubric, visit: http://www.scholastic.com/browse/lessonplan.jsp?id=1504
Infographic	• Students create an image, such as a chart or diagram, used to represent information or data. Infographics make complex information eye-catching, shareable, and easy to digest. • For an easy-to-use infographic creator, visit: https://piktochart.com/.
Blog Post(s)	• Platforms may include Kidblog, WordPress, Blogger, Tumbler.
YouTube Video	• Students create a video about their project or make a recording of their presentation. To learn more about getting started with YouTube in school, visit: https://www.campussuite.com/blog/create-youtube-channel-for-your-school

ELEMENT 7

SHARING FINDINGS AND POST-ASSESSMENT

Student Driving Question: How can I share my recommendation?

SUMMARY

Who: Zoo-facilitated

When: Mid- to late May (for exact date, see Calendar 2019-2020 on page 5)

Time: 2 periods

Where: Classroom

DESCRIPTION

Each student group presents their recommendation (scientific explanation) to zoo staff, who use a rubric to evaluate each presentation. Zoo staff make recommendations to teachers on the top student groups to present at the All School Community Event. Following their presentations, students complete the digital post-assessment as a program evaluation.

OBJECTIVES

By the end of this element, students will be able to…

- Orally present their recommendation (claim, evidence, and reasoning) about how people can better peacefully coexist with carnivores.
- Orally present their investigative process, including their question, claim, methods, and findings.

CONNECTIONS TO NGSS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Engage in argument from evidence (x2)
- Obtain, evaluate, and communicate information

MATERIALS AND PREPARATION

Part One: Presentations

- ❑ Gather Student Packets so zoo staff can make copies and return them
- ❑ Ask students to bring their completed Communication Tools

Part Two: Post-assessments

- ❑ Notify zoo staff of date planned for post-assessment
- ❑ Arrange for computer access
- ❑ Obtain Student Post-Assessment link (available via email or www.zoo.org/wwcwc)

Part Three: Prepare for All School Event

Everyone is welcome to present and/or attend, but students can opt out

- [ ] Receive tri-fold boards from zoo staff
- [ ] Gather glue, markers, or other materials for decorating
- [ ] Print key slides from digital slides for students to put on boards as needed

ACTIVITIES

PART ONE: PRESENTATIONS

1. **Teachers and zoo staff introduce the presentation activity (4 minutes)**

   Zoo staff cover the following information:

   - Each student group will have 5 minutes to present, including 2 minutes afterward for questions from zoo staff or the teacher.
   - Zoo staff will evaluate student presentations using the project rubric, which assess the same elements as outlined on the Student Checklist.
   - After each presentation, zoo staff will ask at least one question to learn more about the investigation, results, or process.
   - Students will also have student presentation feedback forms they can fill out while listening to other presentations.

> **Scientific and Engineering Practices**
>
> **Engaging in argument from evidence**: "*Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail*."

2. **Students give oral presentations (45 minutes)**

   Zoo staff observe students giving their oral presentations.

> **Scientific and Engineering Practices**
>
> **Engage in argument from evidence**: "… *Present an oral and written argument supported by empirical evidence and scientific reasoning to support … an explanation*…"
>
> **Obtain, evaluate, and communicate information**: "*Communicate scientific … information … in writing and/or through oral presentation*."

3. **Give zoo staff Student Packets**

   Zoo staff collect Student Packets from teachers to make copies at the zoo and return within two school days (preferred), or they can make copies at the school and return them the same day. The Student Packets will be evaluated as a program assessment.

4. **Zoo staff send digital scans of completed rubrics to teachers (within two days of visit)**

   Zoo staff will scan and email the completed Sharing Findings rubrics from the student presentations. Once zoo staff have attended Sharing Findings at all schools, they will send out recommendations for groups to attend Element 8.

Note that ALL student groups are welcome to attend and/or present at Element 8, but we will make recommendations for our top favorites. This year the format is different so that ALL students will give their oral presentation with a tri-fold board (science fair style) instead of using slides on a stage. See Element 8 for more details.

PART TWO: POST-ASSESSMENT

5. Students complete post-assessment (20 minutes)

Completion of the post-assessment is a required element of program participation. Results from student assessments are used for internal program evaluation and reporting for a federal grant. The SurveyMonkey link to the student post-assessment will be sent to teachers in May 2020 and be available on the CWC website (www.zoo.org/wwcwc).

6. Teachers complete post-assessment (15 minutes)

Complete the online program post-assessment as soon as possible after your Sharing Findings session with zoo staff. A link will be sent via email and the website (www.zoo.org/wwcwc). You do not need to wait until after the All-School Community Event.

PART THREE: PREPARE FOR ALL SCHOOL COMMUNITY EVENT (OPTIONAL)

7. Students create tri-fold board (45 minutes)

If they haven't already, ask students to create a trifold board to accompany their presentations at Element 8 REF. If they created digital presentation slides for Sharing Findings, an easy way to prepare the board is to print key slides off to put on the board to serve as visual cues while they give their oral presentation. If students are not planning to attend Element 8, they do not have to make a board.

ELEMENT 8
ALL SCHOOL COMMUNITY EVENT
Issaquah Middle School Commons - Wed, June 10, 2020

SUMMARY

Who: Zoo-facilitated

When: Wednesday, June 10, 2020

Time: 2-hour after-school event, exact time TBD

Where: Issaquah Middle School Commons

DESCRIPTION

All student groups are invited to present their projects at the All School Community Event, in the form of a science fair (with tri-fold boards). Community members, including organization leaders from the Issaquah-Sammamish area, partners of the zoo, and civic leaders are also invited to attend and view students' work.

OBJECTIVES

By the end of this element, students will be able to…

- Orally present about their investigative process, including their question, claim, methods, and findings.
- Orally present their claim on how the community can better coexist with carnivores, supported by evidence from their investigation and scientific reasoning.
- Ask questions to learn more about the investigations conducted by other classes.

CONNECTIONS TO NGSS

Same as in Element 7

MATERIALS AND PREPARATION

- ❑ Invite members of the community to attend
- ❑ Arrange to bring (or ask students to bring) tri-fold boards

ACTIVITIES

1. **All students present their research in science-fair style event (1 hour)**

   All student groups are invited to bring their tri-fold board and present to members of the community, including families, Woodland Park Zoo partners, government officials, and zoo staff. There will be food and snacks. More details about the All School Community Event will be provided by WPZ staff in advance of the event.

WESTERN WILDLIFE OUTREACH VISIT

Student Driving Question: Why does (or should) the community care about carnivores?

SUMMARY

Who: Teachers and Western Wildlife Outreach staff (WWO)

When: March or April (for exact date, see Calendar 2019-2020 on page 5)

Time: 1 period

Where: School grounds

DESCRIPTION

Western Wildlife Outreach (WWO) is a local non-profit that shares accurate information about local carnivores. WWO outreach experts use pelts, skulls, and other animal artifacts to engage participants in questions such as: Who are our local carnivores? Why are they important? Why do we (the community) want to coexist with them? Students can also use WWO as a resource for information related to coexisting with carnivores.

OBJECTIVES

By the end of this element, students will be able to…

- Ask questions to develop their understanding of the ecology of local carnivores and strategies for coexistence.

CONNECTIONS TO STANDARDS

See the Facilitator Notes in the activity description of the lesson and guide at the beginning of this document for more details. Descriptions in the Facilitator Notes are from the Appendices (NGSS Lead States, 2013).

Science and Engineering Practices

- Asking Questions and Defining Problems: "Ask questions … to clarify and/or seek additional information."

MATERIALS AND PREPARATION

- ❑ Arrange primary and back-up dates with WWO staff (by January 2020)
- ❑ Arrange space for WWO trailer on school grounds for visit date

ACTIVITIES

1. **Ask students to brainstorm questions about carnivores and their projects before meeting WWO staff (5 min)**

   Help students get the most of their experience by asking them to write down questions they have about carnivores related to their investigative question.

Scientific and Engineering Practices

Ask questions and define problems: "*Ask questions … to clarify and/or seek additional information*."

APPENDICES

APPENDIX A: KEY VOCABULARY

biosphere

The parts of the land, sea, and air in which living things occur on Earth; the global ecosystem of all living things and the non-living things with which they interact.

causation

A relationship of cause and effect, in which an object or event causes something else to be or happen. (see also correlation)

carnivore

A (1) meat-eater or (2) animal that belongs to the Carnivora taxon, identified in part by their carnassial teeth, which evolved to tear and shear flesh.

claim

A statement that answers the investigative question (or driving question for the unit). It will usually only be one sentence in length. The claim does not include any explanation, reasoning, or evidence so it should not include any transition words such as "because."

coexistence

When humans can meet our own needs while also allowing other animals to meet their needs.

confounding factor

An outside variable that changes the effect of the independent (manipulated) and dependent (responding) variables.

control

In an investigation, the observed group that is not manipulated or does not receive treatment. In observational field studies the control group could be the "status quo" group.

correlation

A relationship or connection between two or more things. Note that a correlation does not necessarily mean causation. (see also biosphere

The parts of the land, sea, and air in which living things occur on Earth; the global ecosystem of all living things and the non-living things with which they interact.

causation)

dependent (responding) variable

The variable that you think will depend on (be affected by) the condition of the independent variable. Also known as a "responding variable" in laboratory studies. (see also independent (manipulated) variable)

ecosystem

A biological community of interacting organisms, species, and populations and their physical environment including living and non-living things.

empirical evidence

Empirical evidence is information gathered from observations or investigations.

explanation (scientific)

A way of explaining phenomena in the natural or designed worlds using evidence and reasoning.

independent (manipulated) variable

The variable that has conditions you think cause change or affect the dependent variable. Also known as a "manipulated variable" in laboratory studies. (see also dependent (responding) variable)

investigative question

A question that can be answered by collecting and analyzing data. For this unit, the investigative question explores two or more conditions of the independent (manipulated) variable and whether those conditions are associated with a change in the dependent (responding) variable.

measurement error

Variation in data due to random variation or inaccurate methods.

mean (average)

A number that represents the central value of a data set, calculated by dividing the sum of the values in the set by the number of values in the set.

method (research method)

The process used to collect information. This process produces new knowledge or deepens understanding of a topic or issue.

mode

The value that occurs most frequently in a data set.

model

A scientific model is a visualization tool used to study a system and may be a diagram, physical replica, mathematical representation, analogy, and/or computer simulation.

phenomena

An object or event that is observed, especially one without a clear cause or explanation.

population

A particular group of people or animals living in a particular area.

predator

An animal that eats other animals.

prediction

A prediction is a guess, based on prior observations, that explains what might happen when the outcome is unknown.

prey

An animal that is eaten by other animals.

resource

What humans and other animals need to survive, including living (food, such as plants and other animals) and non-living such as water, light, shelter, soil etc.

APPENDICES

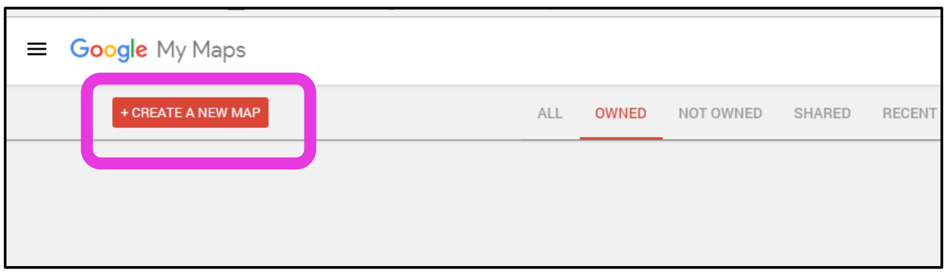
APPENDIX B: CREATE AND EDIT DIGITAL MAPS

Instead of using a paper map, you can create and add sightings to a digital Google Map. You will need to have a Google account to save your map for future use.

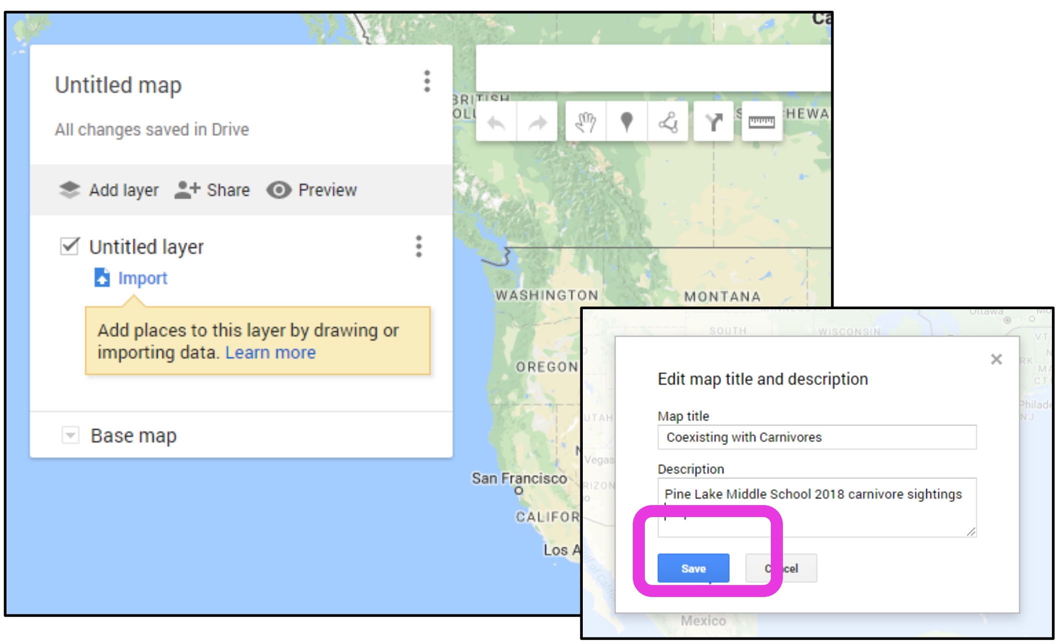
CREATING A SHAREABLE MAP WITH GOOGLE

1. **Go to Google My Maps (https://www.google.com/mymaps)**

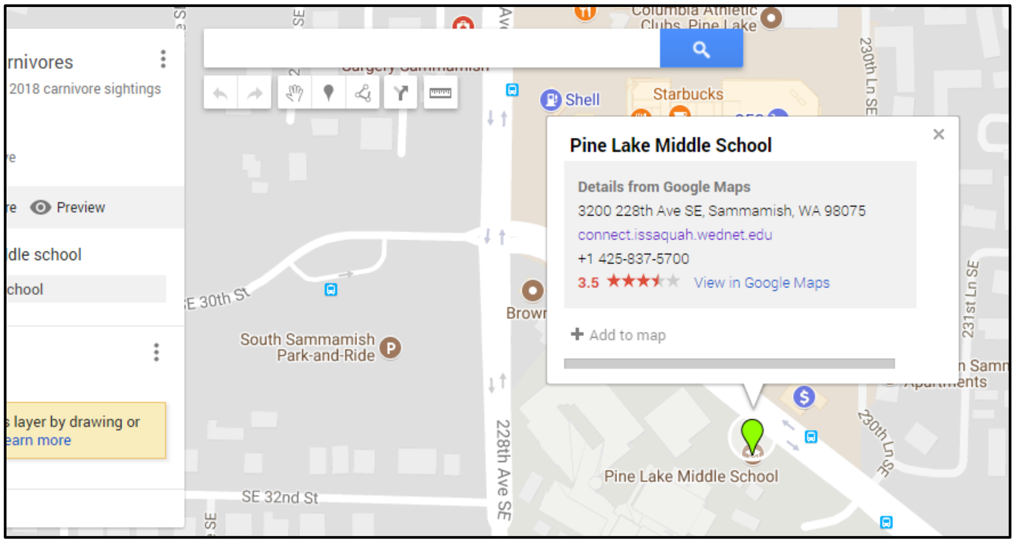
2. **Select "Create a New Map."**



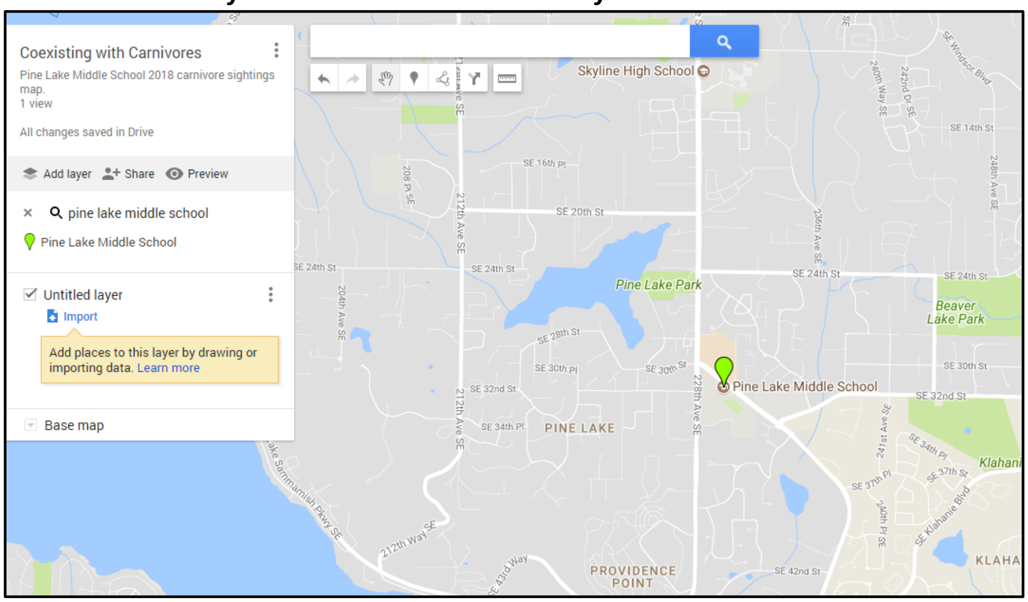
3. **Give your map a title and description by clicking "Untitled map" in the upper left corner. A new box will pop up that you can fill in with this information. Then, click save.**



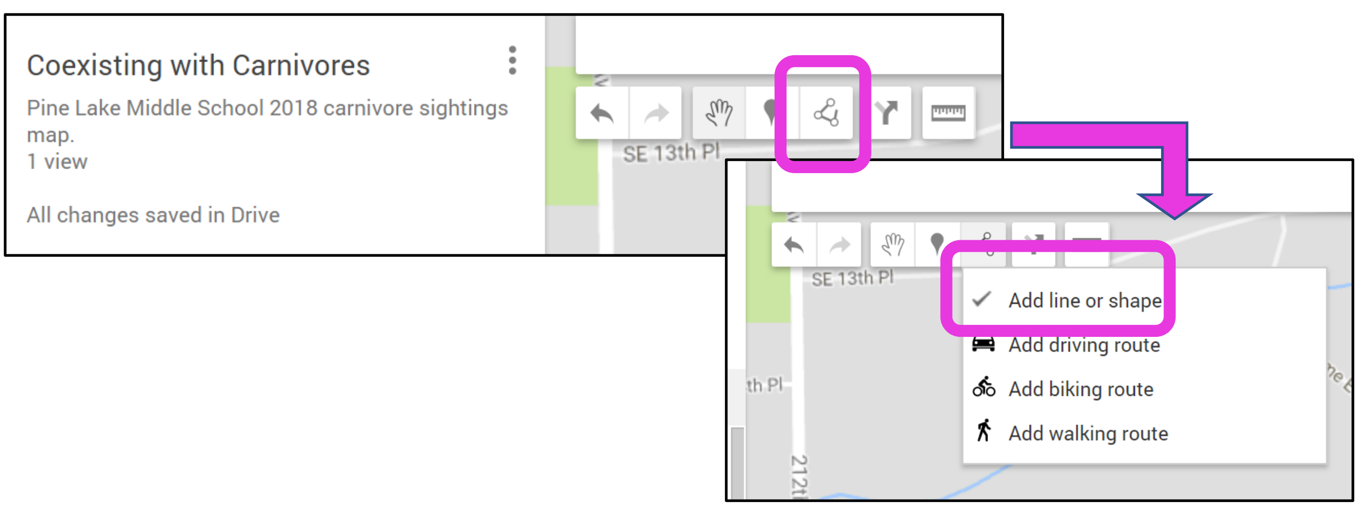
4. **Type the name of your school into the search bar and press enter. The map will find and zoom to your location.**



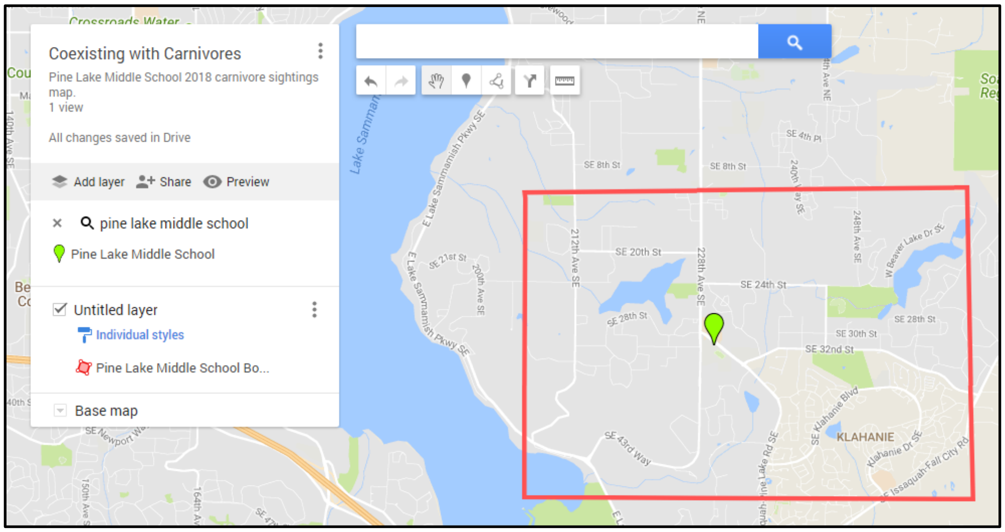
5. **Zoom out so that you can see the area around your school.**



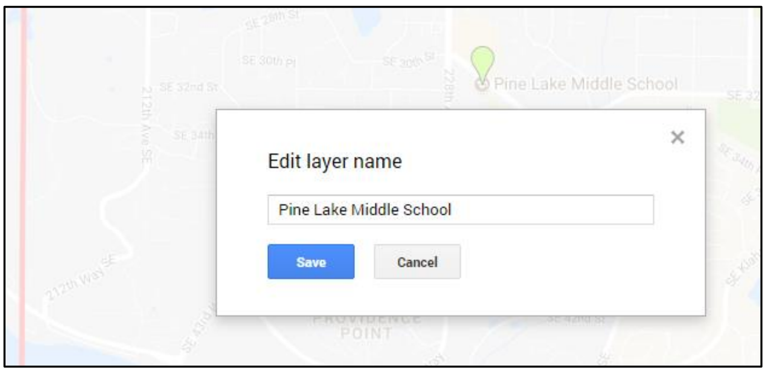
6. **Draw a boundary around your community, this will help others once you share your map. First, select the line icon.**



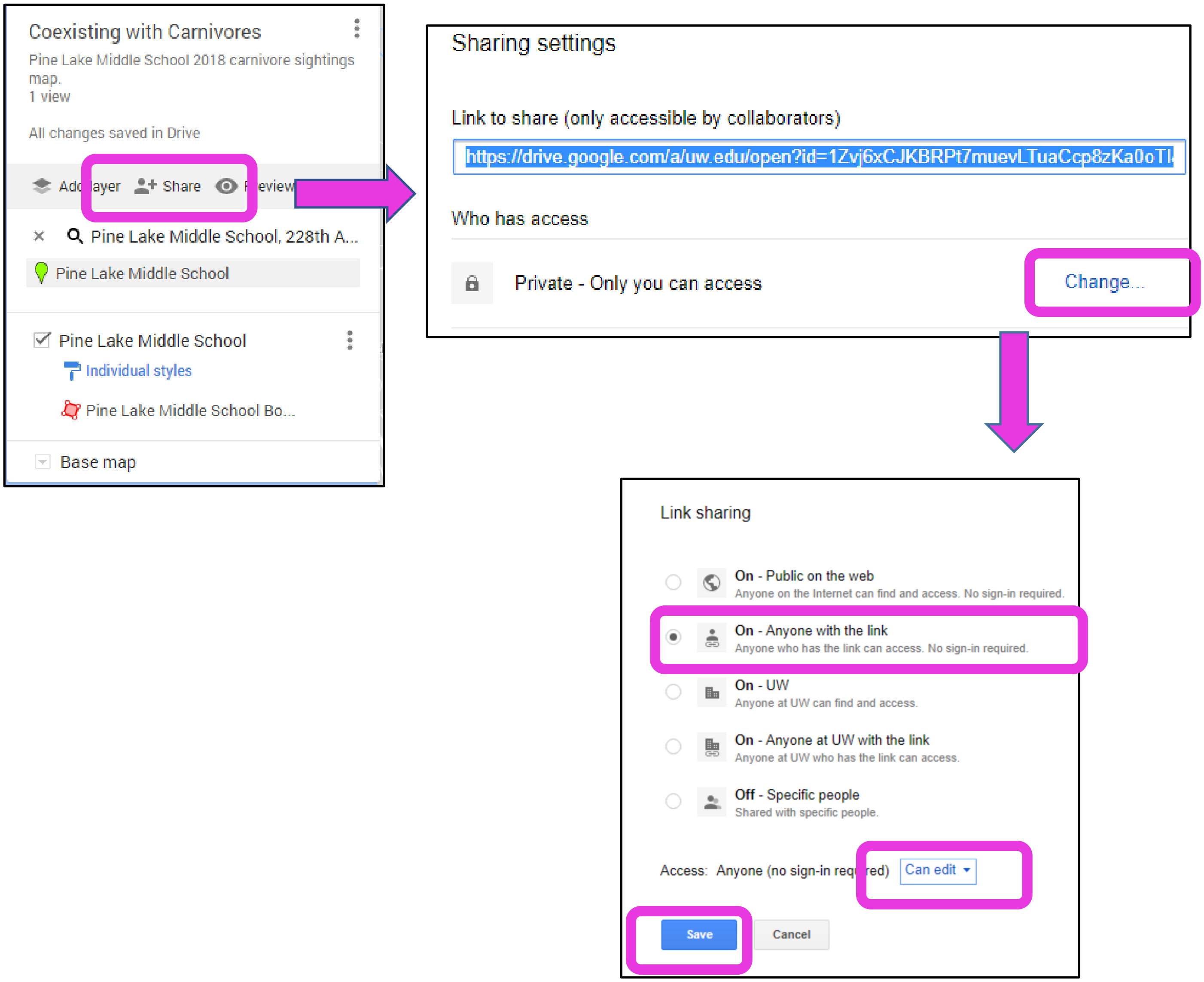
7. **Draw a square around your community using the cursor.**



8. **In the left-hand box, select "Untitled layer". Give your map layer a name (such as the name of your school).**



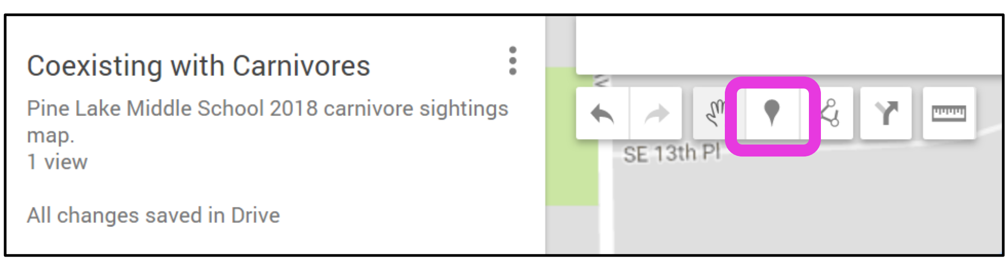
9. **To share your map with others, select the share icon. Under "Who has access" select "Change". When the Link Sharing window appears, change your sharing settings to "On-Anyone with the link". Press save. Copy the link and email to others to gather sightings.**



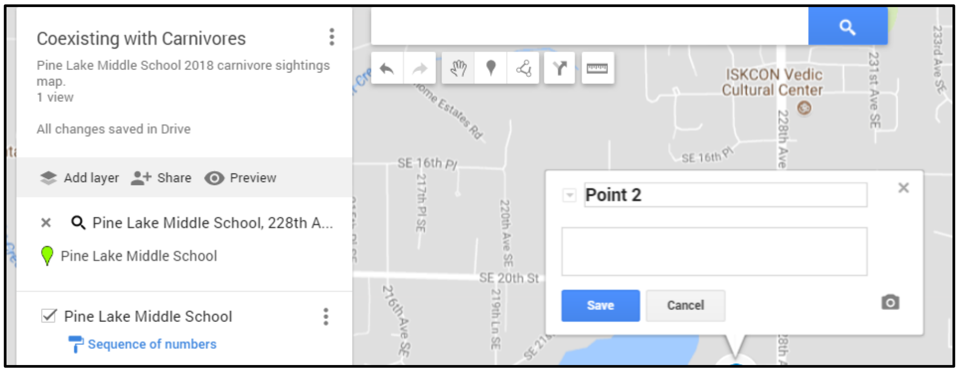
ADDING CARNIVORE SIGHTINGS TO YOUR MAP

1. **Find the location of your carnivore sighting on the map.**

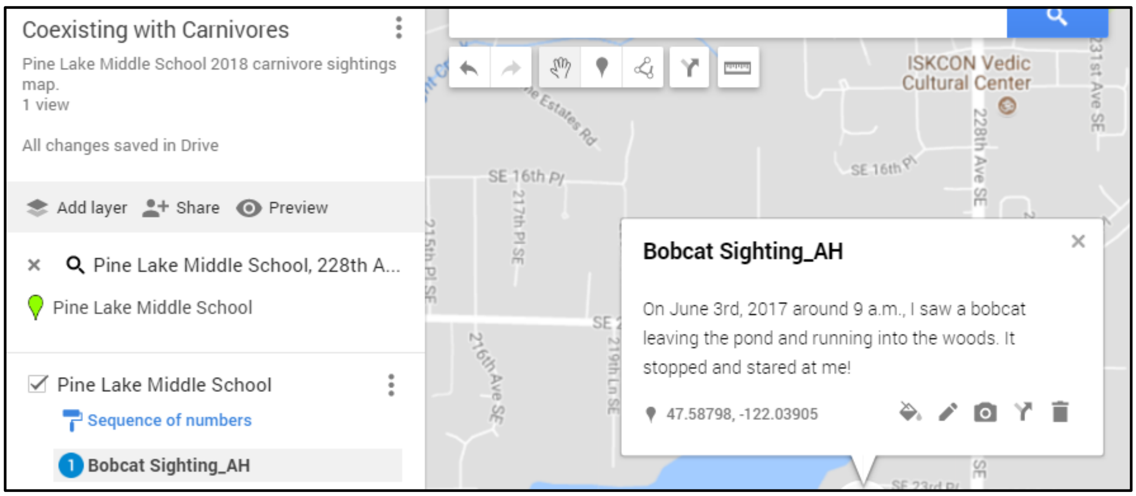
2. **Select the Drop Pin icon.**



3. **Click on the map to drop your pin in the correct location. Rename your pin with the name of the carnivore that was sighted or the type of carnivore sign that was found.**



4. **In the description box, provide details about your experience, such as date, time, and/or a description of the carnivore's behavior. Your class may choose to ask for different information, depending on their investigative question.**



APPENDICES

APPENDIX C: MAP RESOURCES

CITY OF ISSAQUAH MAPS

https://www.issaquahwa.gov/1120/Static-Maps

Includes static maps that can be useful for the following categories:

- Land Use Designation: Residential vs. commercial areas
- Snowplowing Priority: Large vs small roads
- Streams Classification: Stream locations throughout the city

KING COUNTY MAPS

Includes interactive and static maps

- Parcel Viewer: Identify property boundaries (https://www.kingcounty.gov/services/gis/Maps/parcel-viewer.aspx)
- Recreation Maps: https://www.kingcounty.gov/services/gis/Maps/vmc/Recreation.aspx
    - Backcountry Trails map series, including Cougar Mountain, Tiger Mountain and others
    - Regional Trails in King County
- Transportation: Road index map book for different sizes of roads (https://www.kingcounty.gov/services/gis/Maps/vmc/Transportation.aspx)

APPENDICES

APPENDIX D: ONLINE SURVEY RESOURCES

Unsurprisingly, there are many online survey tools available. The options become more limited when looking for free options that will accept more than 100 responses (which has happened in past years). For each of the following options, we considered cost, number of responses allowed, number of questions allowed, and data export capability and options.

SURVEYMONKEY

https://surveymonkey.com

The zoo has a paid account and we have helped create and share surveys in the past. If you would like us to create a survey for your students, you just need to submit their questions to us before spring break.

- **Price**: Free or "Basic" account has some limitations; paid account at least $32/month
- **Prerequisites**: Need working email address to create user account
- **Creating surveys**
  - Create unlimited number of surveys, regardless of account type
  - 10 questions per survey for free account, unlimited questions for paid account
  - Collaboration is limited; would need to access survey as a class
- **Collecting data**
  - Up to 100 responses for free account, unlimited responses for paid account
  - Anyone with survey link can respond
- **Analyzing or exporting data**
  - View data in graphs; 1 filter available in free account, paid account has more filters
  - Cannot export data in free account, paid account can export to CSV, PDF, PPT, XLS

MICROSOFT FORMS

https://forms.office.com

Issaquah School District is a Microsoft district, so this may be the easiest option if you are already used to these tools.

- **Price**: Free
- **Prerequisites**: Need active Microsoft ID to create surveys, access to Microsoft Excel to analyze data easily
- **Creating surveys**
  - Pre-existing templates: "Form" and "Quiz"
  - Collaboration: With Office 365 you can add multiple people for editing ("Share to Collaborate")
- **Collecting data**
  - Unlimited number of responses allowed
  - Anyone with survey link can respond
- **Exporting data**
  - Can import the data to Microsoft Excel and download the spreadsheet

GOOGLE FORMS

https://www.google.com/forms/about/

A detailed how-to guide for using Google Forms is available online at Google Forms Training and Help.

- **Price**: Free

- **Prerequisites**: Need a free Google account to create survey
- **Creating surveys**
  - Pre-existing template: A large variety
  - Can be edited by multiple users, even if they don't have a Gmail account
- **Collecting data**
  - Anyone with the link can respond
  - Unlimited number of responses allowed
- **Exporting data**
  - Survey responses will automatically populate into a Google Spreadsheet, in which you can create graphs
  - Can export data to use in Microsoft Excel

COLLECTING DATA VIA FACEBOOK

If students want to share the link through their personal network, they can post a link to share on their profile. Students could also create a Facebook poll on their profile by including it in their story. If multiple students wanted to share the same survey, they would each have to build it independently. Alternatively, students could create a poll and share it to a Group (anyone in the group can do this) or to a Page (only admins or editors can do this).

APPENDICES

APPENDIX E: EXISTING DATA ON CARNIVORES

CARNIVORE SPOTTER

https://carnivorespotter.org/

This tool is part of a joint project between Woodland Park Zoo and Seattle University. Launched in Summer 2019, this desktop and mobile-friendly tool allows local residents to report observations of carnivores. Students can explore entries via the map. Contact zoo staff to request exported data.

EMAMMAL

https://emammal.si.edu/

eMammal is a research project created by the Smithsonian Institute with photos from field cameras all over the world. The data uploaded here includes Woodland Park Zoo field camera projects in Issaquah (specifically, cameras installed at Tiger Mountain, Cougar Mountain and Grand Ridge Park). See this page for information on how to download data from eMammal: https://emammal.si.edu/analysis/data-download

INATURALIST

www.inaturalist.org

These are verified, research-grade observations from iNaturalist. Data can be exported for an area from the Global Biodiversity Information Facility (https://www.gbif.org/dataset/50c9509d-22c7-4a22-a47d-8c48425ef4a7)

WDFW ONLINE MAPS

https://wdfw.maps.arcgis.com/home/index.html

Create a free login to access maps of wildlife sightings. Includes many types of animals from fish to birds and amphibians.

APPENDICES

APPENDIX F: DEVELOP SURVEY QUESTIONS

1. **Review the prediction graph, determine what information is needed (5 minutes)**

   Begin by having students review their prediction graphs. Ask students what information they need to know in order to give the information.

2. **Students brainstorm survey questions (5 minutes)**

   Ask students to work in small groups to brainstorm what questions they would like to ask.

3. **Students select and revise their top two or three key questions (5 minutes)**

   Ask students to work together to select their top 2 or 3 questions that they think will be most helpful for their investigation.

   Frame this task through a discussion of the importance of asking only key questions needed to gather data to answer their investigative question. People can get survey fatigue if it is too long or has lots of open-ended questions. You can have them think of times where they have taken a long test or survey. There are many questions that might be fun or interesting, but it may not help their investigation.

4. **Revise key questions (10 to 20 minutes)**

   Students can work in small groups or as a class. Take the following into consideration when revising questions:

   - Structure questions as multiple choice, rather than open response (text box entry). Data analysis will be easier since you can compare numbers of responses, rather than reading every answer and "coding" it (creating a category).
   - If using Google maps, respondents will usually only mark the location and recall the type or number of carnivores. They may forget to include time of day or other information students ask for because you cannot have a form within the editing tool for maps. Carnivore Spotter may have additional data linked to a sighting.
   - Clarify any words that people might not understand. If you say "carnivore," will people know what animals in particular you are interested in?
   - Clarify the conditions of your independent/manipulated variable. For example, if you are collecting data on "close to a road," how close is close? 100 feet? 5 feet?
   - Clarify the geographic area that you are asking questions about. Do you want information about carnivores they have seen anywhere or just in a particular area (e.g. Issaquah and Sammamish)?
   - Define the timeframe for reporting. Do you want people to report every carnivore as far back as they can remember, or a more recent time? Students usually settle on asking about sightings within the past 1 to 2 years.

5. **Compile questions and determine final 3 to 4 questions (5 minutes)**

   There will likely be overlap in questions, so encourage students not to repeat questions if they are getting at the same point. Students can focus their suggestions on wording tweaks to create questions that are as clear as possible.

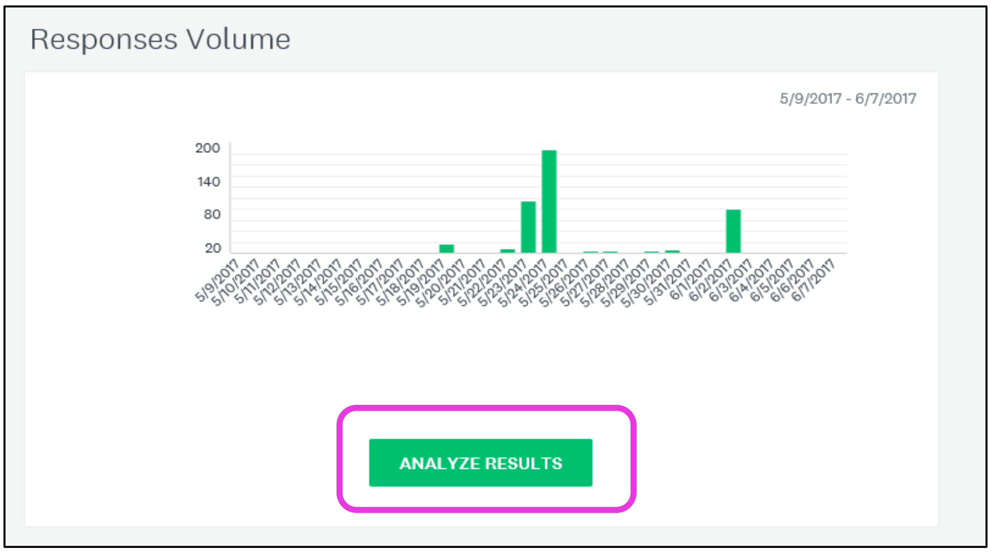
APPENDICES

APPENDIX G: SURVEYMONKEY DATA ANALYSIS

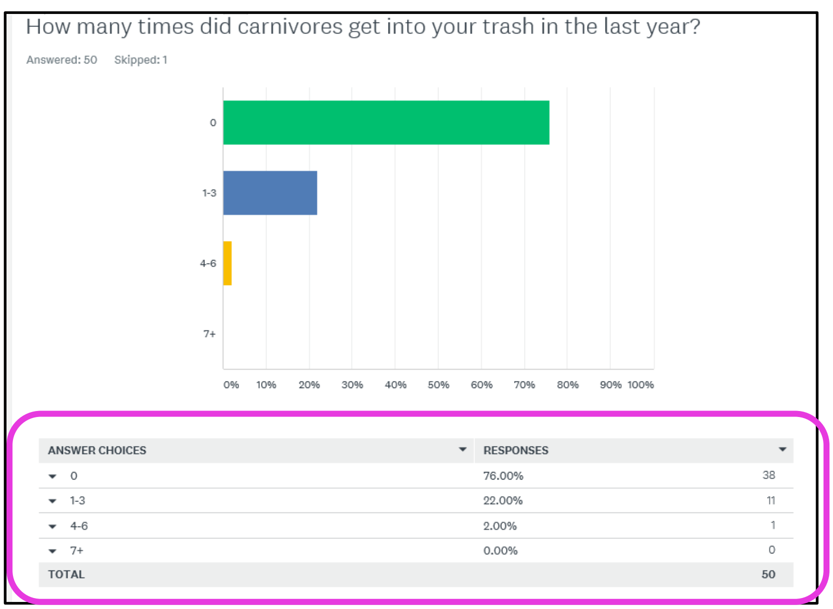
1. **Login using your email and password.**

2. **Select the "Coexisting with Carnivores Student Survey 2019" by clicking the link.**

3. **Select "Analyze Results"**

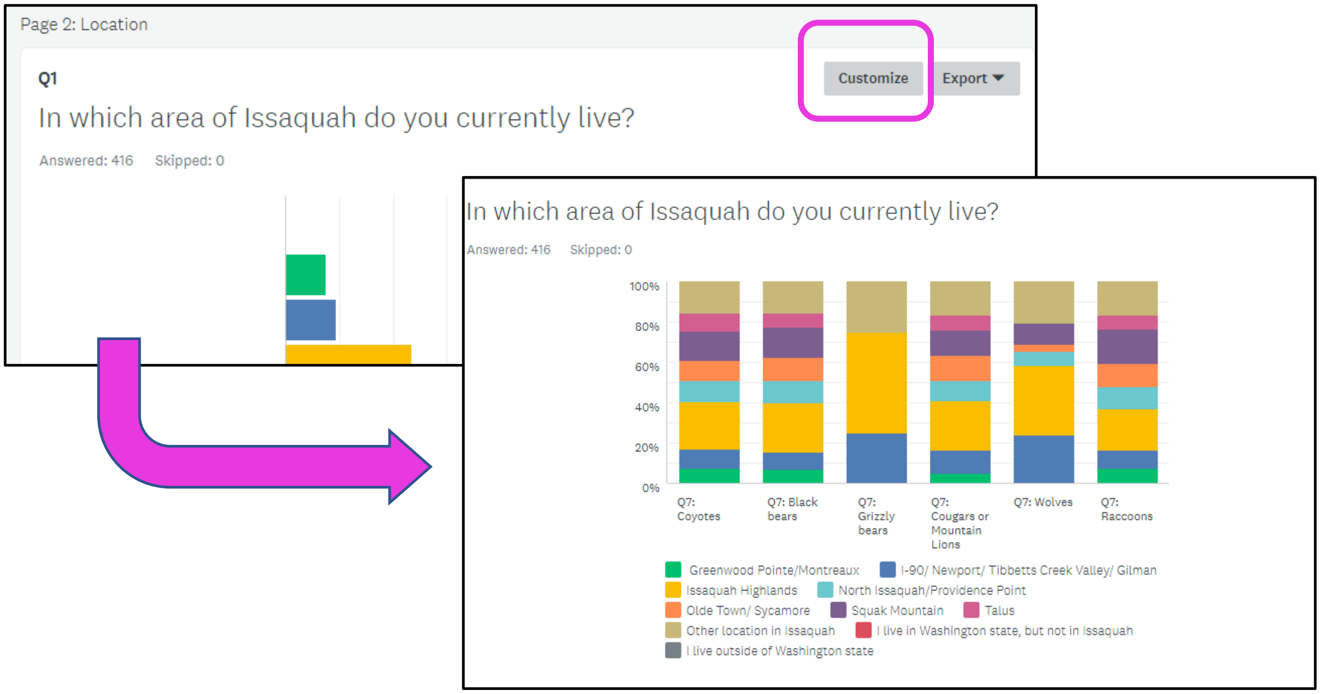


4. **For each question, responses will show up in graphs and charts with both percentages of responses and total number of responses.**

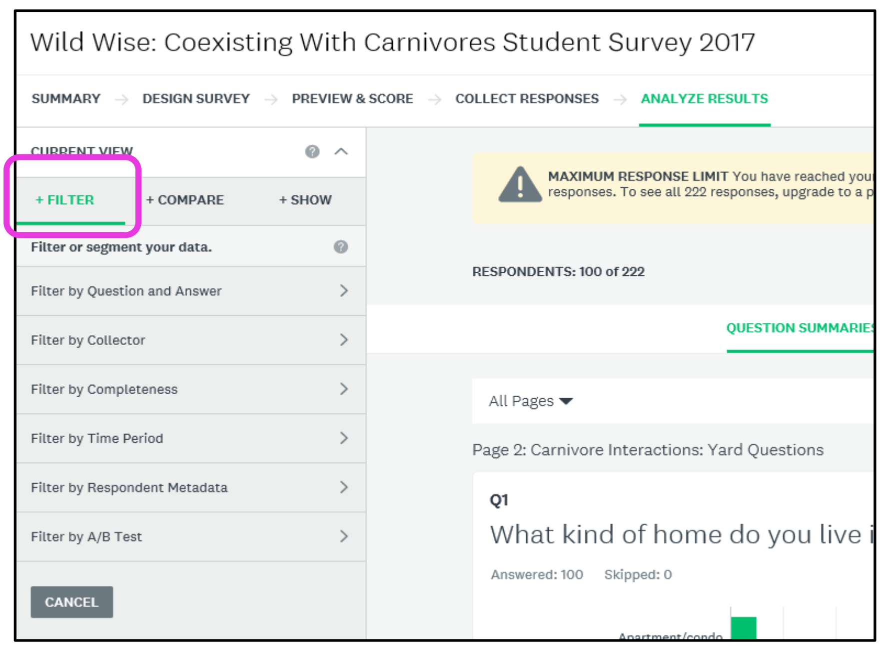


ANSWER CHOICES	RESPONSES	
0	76.00%	38
1-3	22.00%	11
4-6	2.00%	1
7+	0.00%	0
TOTAL		50

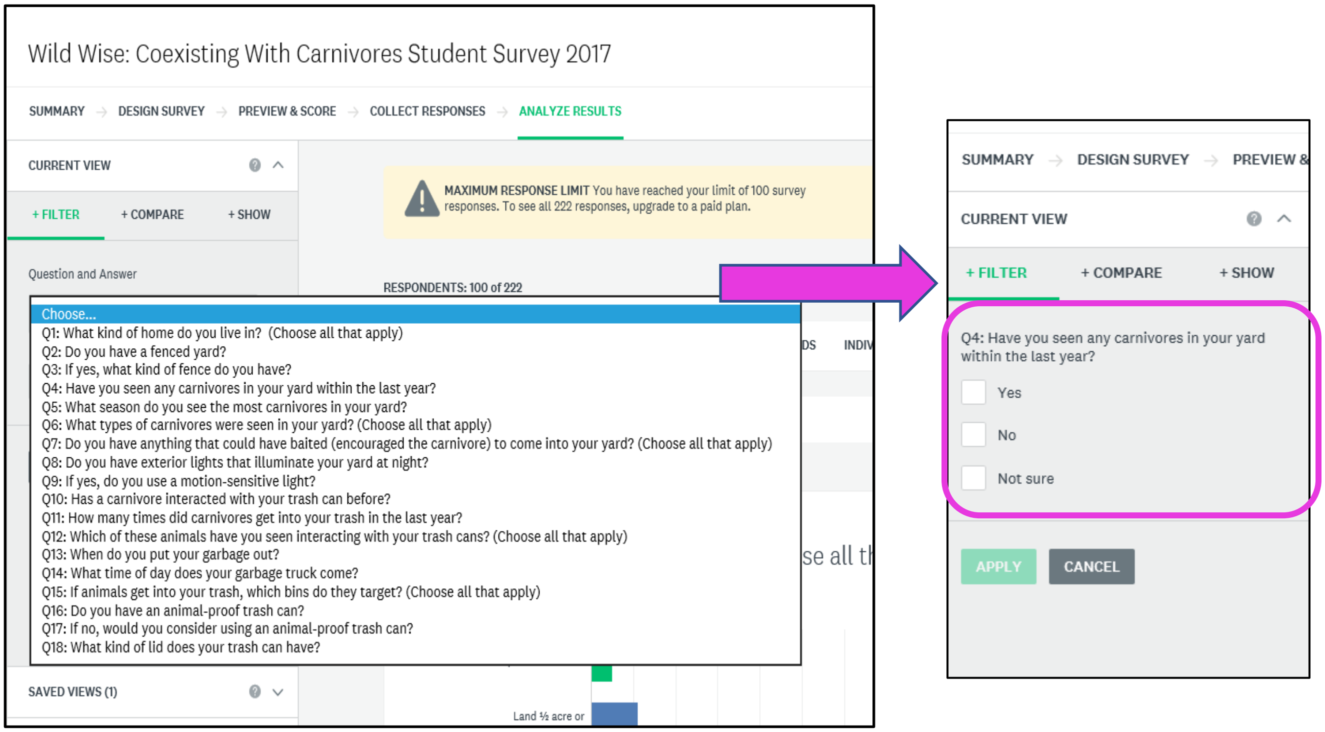
5. **You can change the type of graph by using the "Customize" button.**



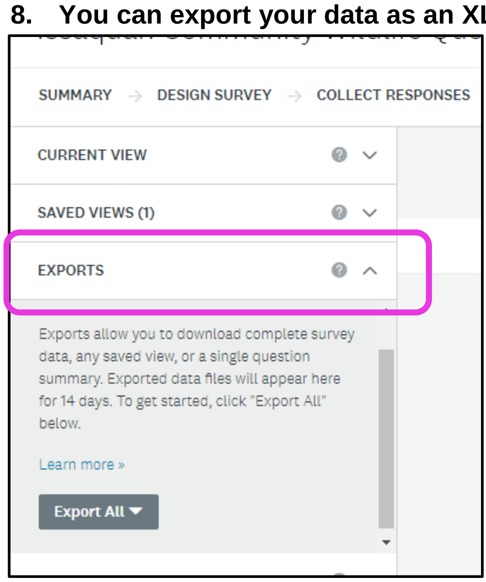
6. **You can use the "Filter" function to analyze your data even further.**

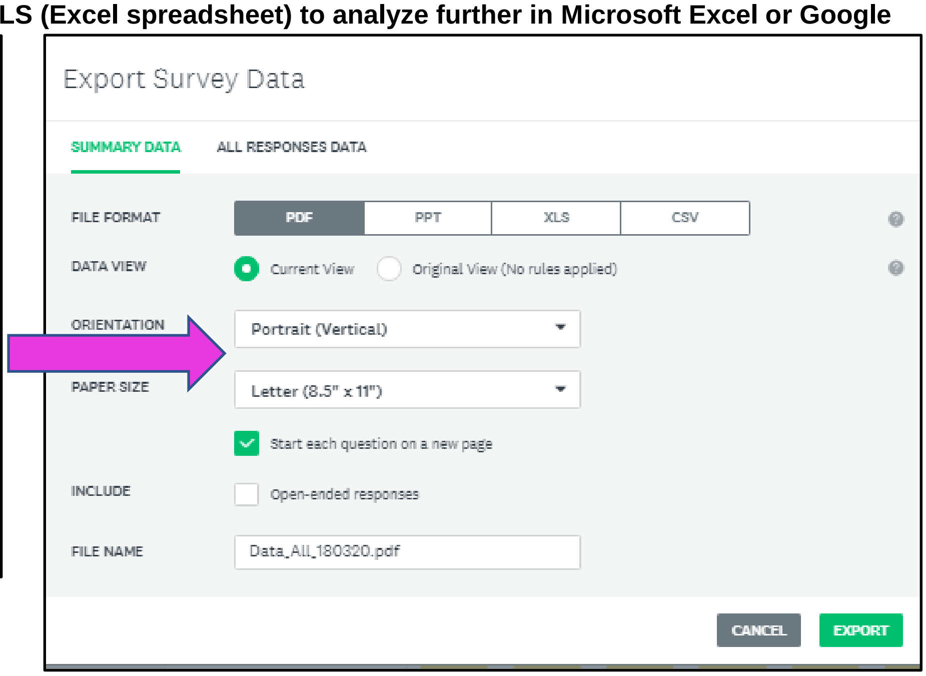


7. **You can filter by question and response. For example, if you want to see everyone who answered "yes" to "Q4: Have you seen any carnivores in your yard within the last year?", scroll down to select the question. Once you have selected the question, you can select the response that you are interested in investigating further.**



8. **You can export your data as an XLS (Excel spreadsheet) to analyze further in Microsoft Excel or Google Sheets.**





APPENDICES

APPENDIX H: ANALYZING DIGITAL MAP DATA

We highly recommend creating a copy of the map before analysis to back up the data.

1. **As a class, recall the categories of the independent/manipulated variable (5 minutes)**

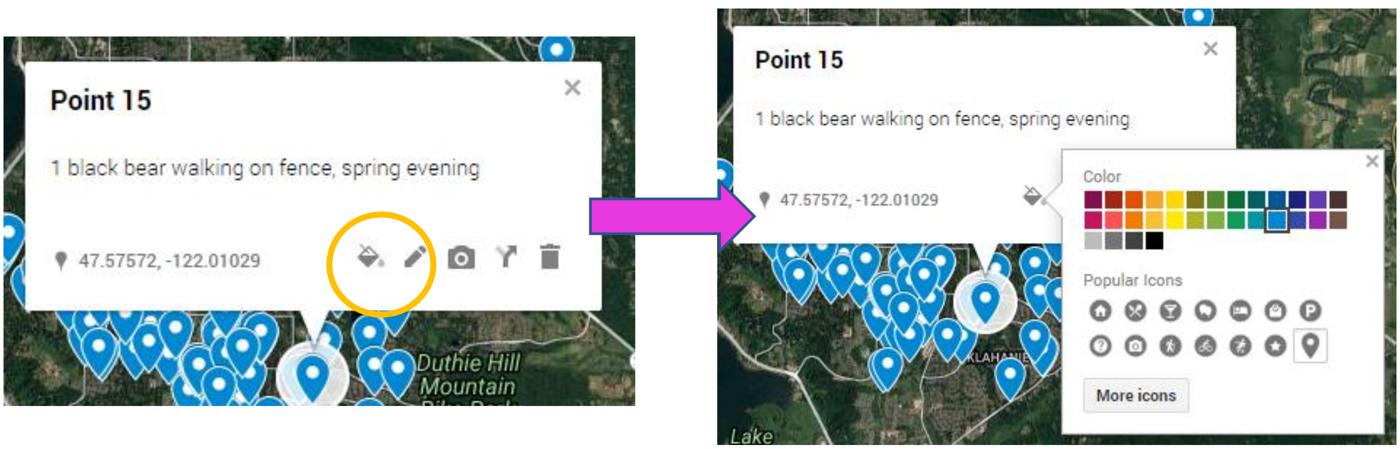
   If helpful, review the prediction graph. Review the definition of each category; for example, how far is "close to a road" or what roads did they determine was a "busy road"?

2. **Assign each category a color or symbol and create a key for your map coding (5 minutes).**

   You can do this on the board, and it can be as simple as "blue" for one category and "red" for the other category.

3. **Review each data point and "code" it by changing the color to match the key.**

   To do this, click on the point and use the paint can icon to choose the color that corresponds to the category for the point. If you have multiple computers, students can work in groups to color code different areas.



4. **If a data point is incomplete and does not contain the information you need to code it, delete it using the trash can icon.**