IGNITE MY FUTURE

THINK SOLVE CREATE CONNECT

LESSON TITLE

Saving Species

with Smartphones

Guiding Question: How can we connect to one another?

Ignite Curiosity

- What types of information can you gather with your smartphone?
- Can smartphones and apps help protect endangered species?
- Can teenagers offer useful contributions to scientific research projects?
- How could scientists use data people collect with their smartphones?
- Why might getting data from lots of people help scientists with their research?

In this lesson, students will explore how location technology, such as the Snapchat location feature, could be used to help scientists gather data about endangered species in our ecosystems. They will also consider how it might be possible to automate the collection of important sets of data and include public volunteers in that process. Then, students will examine how collaboration on a public level can be used to analyze and interpret that data. In **THINK**, students will assume the role of a zoological research team challenged to identify endangered species living in an ecosystem. In **SOLVE**, they will design a process by which the public can participate in collecting and analyzing data about the ecosystem. In **CREATE**, students will collaborate to design a website map that demonstrates one way the public could engage in the project. In **CONNECT**, students will explore some real-life examples of how the public is invited to participate in scientific projects and identify how collaboration using technology connects to the careers and problems of tomorrow.

Students will be able to:

- **Examine** the roles of technology and public collaboration in scientific research,
- **Create** a model of a website map designed to crowdsource data, and
- **Analyze** quantitative data about species populations.

SUBJECTS

Science
Technology
Engineering
Math
Computer Science

COMPUTATIONAL THINKING PRACTICE

Collaborating Around Computing

COMPUTATIONAL THINKING STRATEGIES

Collect Data
Analyze Data

MATERIALS

Writing materials

Computers/devices with Internet access and word-processing capabilities

Technology Evaluation student capture sheet

Plan Summary student capture sheet

Students will assume the role of a zoological research team challenged to identify endangered species.

1 **Read** the following scenario to the class:

You are a member of a team of zoologists studying various ecosystems and the populations of various species in those ecosystems. Your team's goal is to track species populations, especially endangered and threatened species, to determine how to support those populations. Budget constraints mean your team is only able to take short excursions into the ecosystems and has limited hours to spend analyzing data. You have incomplete knowledge about what species are present, how many of each species are present, and where they live. You intend to utilize any helpful technology available to collect data and hope to take advantage of public volunteers to help analyze that data and identify prime locations for each species.

2 **Discuss** the scenario with students using the following guiding questions:

What is the goal of the project? How would the extinction of a plant or animal impact other plants and animals in a food chain and food web?

- Be sure that students' answers include a recognition that the final goal is to support wildlife populations.

What must your team do to accomplish the goal?

- What type of information would be useful beyond mere population numbers for each species?

What obstacles does your team face?

3 **Introduce** a key piece of technology that will be incorporated into student solutions: location technology on mobile devices.

What other features of mobile technology could be useful data collection tools?

What existing apps make use of this technology, and could they be utilized for this project?

- Snapchat is a picture-sharing app. Users share photos and choose how long each photo remains accessible before being deleted from the recipient's phone. An additional feature that has been added to the app is called the Snap Map. It allows users to share their location data to a general map for others to see.
- Drop Messages is a messaging app that allows users to "drop" messages to a specific geographic location for others to see when they are in that vicinity. When another user with that app comes near the location of the dropped message, that user is notified about and can access the message.
- Piximity is a location-based photo-sharing app. Users are able to share photos from their location anonymously, and can then sort the entire database of shared photos based on proximity to their location.

4 **Introduce** the key question to consider for the Solve section (students will discuss it in groups during Solve): How can these features of mobile technology be harnessed for public contribution to this project?

Students will design and create a plan for accomplishing the scientific research that uses limited amounts of the research team's time and incorporates public volunteers and popular technology. The plan will include a dedicated website to enable volunteers to participate in the project.

1. **Split** students into small groups of three to five.

2. **Explain** that each group will design a plan for how to accomplish the research.
   - The plan should include a way for the public to participate using technology commonly found in mobile devices. It can include other technology as well.
   - In the next portion of the activity, each group will create a website map that the public can use to interact with the project. The groups do not need to create that artifact yet, but they should keep in mind that a website will be part of the plan.
   - Volunteers cannot be expected to have thorough scientific training and expertise.
   - The best plan will be effective in terms of both thorough data collection and analysis and minimizing cost.

3. **Distribute** a copy of the Technology Evaluation student capture sheet and the Plan Summary student capture sheet to each group.

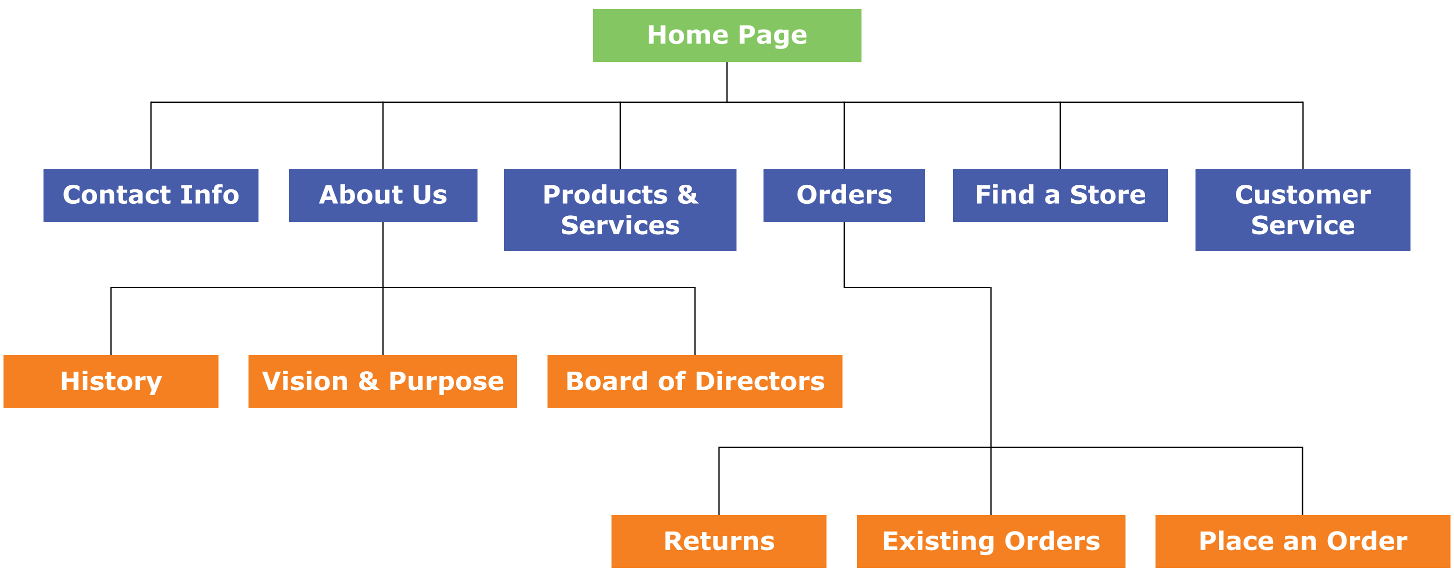
4. **Ask** each group to start with the Technology Evaluation student capture sheet. They will use it to identify and evaluate potential types of technology that could be utilized in the research project.

5. **After identifying a list of potential technologies,** ask groups to select a few key ideas and collaborate to develop a strategic, comprehensive plan. They will use the Plan Summary student capture sheet to record and describe their plan.

Students will create a website map that provides a basic design plan for the website volunteers will access, and they will create a sample set of data that volunteers would collect (such as charts of number, type, and location of species) and provide examples of the types of analysis that can be made on those data sets.

1 **Explain** to students that they will now design a simple graphic website map that visually represents the structure of a website that volunteers could use to participate in the project.

Show students an example of a basic website map. Here is a very simple example:



Here are some links to more examples of sitemaps:

- https://upload.wikimedia.org/wikipedia/commons/2/20/Sitemap_google.jpg
- http://karlcleveland.com/165/sitemaps.htm
- https://s-media-cache-ak0.pinimg.com/originals/84/4f/bc/844fbc1ef7211abd0976a2600556a1b8.jpg

Discuss key terms, such as "home/landing page" and "navigation menu/links."

Discuss: What parts need to be present on the website?

- For example: app to download, way to contribute to data analysis stage, general information about the project, contact information.
- What unique aspects of your plan need to be represented?

Ask groups to create their website map.

- Students can use pencil and paper to create their maps, or a relatively easy tool to use for this would be Microsoft Word's "SmartArt" feature, which allows users to create hierarchical layouts.

Invite each group to present its website map to the class.

2 **Explain** to students that they will now create a small sample data set that illustrates at least one type of analysis that could be done with the data being collected.

Discuss the types of data that might be available for analysis using the following guiding questions:

- What type of data would volunteers gather directly during the project?
- Are there additional data that volunteers could add later as they analyze raw data?
  - For example, if volunteers submit pictures from mobile devices, could other volunteers add other data to be associated with each picture, such as number of the species being shown, type of surroundings, and weather conditions?
- What external data might be useful to link to the data collected during the project?
  - For example: general climate data such as rainfall, average seasonal temperatures, and temperatures in that area on the day the data were collected.

Discuss the types of data insight that you might be looking for in the analysis process.

- Are two (or more) data categories correlated?
  - Explain what data correlation means.
- Are there trends in a given data category over time?
  - Are there corresponding trends in other data categories?

Instruct each group to create a sample set of data that demonstrate at least one identifiable insight.

- The data set should include multiple data categories.
- It can also include multiple locations and times, if desired.
- Make sure the data categories represented could reasonably be gathered through your data collection plan.

Allow each group to share its data set, and ask the other groups if they see any insights based on the data. **Examples might include:**

- Sightings of two animal species tending to be near each other in the same location
- Inverse relationship between the populations of two animal species; that is, as the population of one species increases, the other tends to decrease
- An animal species tending to be seen more frequently near a particular plant species
- A trend of increasing or decreasing populations of a species over time
- Common conditions under which a particular species is thriving in multiple locations

When students recognize an insight, discuss whether the insight suggests an action that could be taken to support the species under consideration. Ask students to summarize their learning using the following guiding questions:

- How does collecting and analyzing data help collaborative efforts towards a common goal?
- How could your design solution help zoologists, scientists, and others maintain a balanced and healthy ecosystem?

Students explore some real-life examples of how the public is invited to participate in scientific projects and identify how collaboration using technology connects to careers and to problems of tomorrow.

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1. **Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
2. **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
3. **Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
4. **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

There are endangered or threatened species in every state. Students would be capable of contributing data in a project of this sort, especially if they have access to a mobile device. There are several online crowdsourced data projects in which students can participate.

How does this connect to careers?

Web Developers design, create, and modify websites. They analyze user needs to implement website content, graphics, performance, and capacity. They may integrate websites with other computer applications.

Zoologists and Wildlife Biologists study the origins, behavior, diseases, genetics, and life processes of animals and wildlife. They may specialize in wildlife research and management, and they may collect and analyze biological data to determine the environmental effects of present and potential use of land and water habitats.

Conservation Scientists and Foresters manage the land quality of forests, parks, and other natural resources. Their work can protect the species that live in the ecosystems they oversee.

How does this connect to our world?

Ecosystems are complex, and the interdependency among species is significant, though it is difficult to measure. The loss or significant reduction in numbers of any one species can have a chain effect on many other species in that ecosystem, and humans are also often impacted by these consequences.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data ▪ Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) **ETS1.A: Defining and Delimiting Engineering Problems** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)	**Patterns** Patterns can be used to identify cause and effect relationships. (MS-LS2-2) **Stability and Change** Small changes in one part of a system might cause large changes in another part. (MSLS2-4),(MS-LS2-5) **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

COMMON CORE STATE STANDARDS CONNECTIONS

- **ELA/Literacy RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
- **ELA/Literacy SL.8.5** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-LS2-3)
- **Mathematics MP.4** Model with mathematics. (MS-LS2-5)
- **Mathematics 6.SP.B.5** Summarize numerical data sets in relation to their context. (MS-LS2-2)

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 2. Collaborating Around Computing Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts.

Practice 7. Communicating About Computing Communication involves personal expression and exchanging ideas with others. In computer science, students communicate with diverse audiences about the use and effects of computation and the appropriateness of computational choices. Students write clear comments, document their work, and communicate their ideas through multiple forms of media. Clear communication includes using precise language and careful considerations of possible audiences.

Technology Evaluation

Consider the following questions as you identify potentially useful technologies:

- Are there existing mobile apps that can be utilized for the project, or would a custom app be more appropriate?
- Should technologies other than mobile devices be incorporated?
- Are some technologies cost-prohibitive? Are there lower-cost alternatives to some of these technologies?
- Are the technologies that are listed easy for volunteers to access and use? Do some need to be used by trained professionals only?

Technology Name	Description	Cost (High, Medium, or Low)	Ease of Use (High, Medium, or Low)

Plan Summary

Summary of Plan:

Technologies Utilized:

Rate your plan in each of the following areas:

Cost Efficiency

LOW | MEDIUM | HIGH

Required Expert Involvement

LOW | MEDIUM | HIGH

Ease of Volunteer Involvement

LOW | MEDIUM | HIGH

Ease of Plan Implementation

LOW | MEDIUM | HIGH

Thoroughness of Data Collection

LOW | MEDIUM | HIGH

Thoroughness of Data Analysis

LOW | MEDIUM | HIGH