



Activity 4: iNaturalist Data Exploration

Grades: 9-12

Time: 60 minutes

Location: Home + Classroom

Big Ideas/Themes

- Biodiversity and Society
- Citizen Science and Open Science
- Science Practices and Skills

Essential Questions

- How did observations from your city **compare** to results from other cities?
- How can observations from the iNaturalist City Challenge (CNC) **contribute** to citizen science?
- What are the **benefits** and **limitations** of iNaturalist to observe/measure global biodiversity?

Objectives

- Students will **compare/contrast** observations in different cities from the City Nature Challenge
- Students will **practice** scientific skills such as analyzing data, drawing conclusions, and communicating results
- Students will **investigate** the presence of invasive, threatened, and endangered species, and species with unique adaptations in their communities
- Students will **draw inferences** about the habits, preferences, and biases of observers
- Students will feel **connected** to their local ecosystem and community, and understand how their knowledge can be applied globally
- Students will **reflect** on their contributions to citizen science, and identify their role as valuable members of the scientific community

Abbreviations

- City Nature Challenge is abbreviated as CNC
- iNaturalist is abbreviated as iNat

Activity Snapshot

This activity seems long - but consists mostly of a worksheet. Here is a snapshot - students will...

1. Research the landscape, population, and wildlife of other cities (complete before class)
2. Explore results of CNC - optional adaptations and conservation questions (30 min)
3. Create and share posters of their city results, comparing to your closest city (25 min)
4. Discuss iNaturalist, CNC, and the value of participating in citizen science (5 min)

Directions

Preparation

In this activity, students will explore iNaturalist data by comparing the results from cities that participated in the [iNaturalist City Nature Challenge 2018 project](#). Assign or have students choose a city they would like to investigate (see list below). Try to cover every city or choose cities from different parts of the world. Note: Not all cities use iNaturalist and there is a large spectrum of number of observations. Look at [city list](#) and visit individual projects first before deciding if you will use all or some cities. Have students research the following about their cities as a baseline for exploring observations in

preparation for the analysis part of this activity and record the attached worksheet:

- City population/metro area population
- General size of survey area
- Climate information (average temperature, precipitation, etc.)
- Geological and water features – what kind of landforms? Rivers? Lakes? Marshes? Ocean?
- Dominant biotic communities/dominant vegetation of those communities
- Presence of parks and open spaces in urban areas (as an extension, use Google Earth to estimate)
- Compare/contrast the number and kinds of species they expect be observed in the area to your area (or nearest participating city)

Engage

Ask students about initial impressions of participating cities:

- Which city do students expect to find the most species?
- Which city do students expect to find the most observations?
- What kinds of species do they expect to find in each city?

Have students guess how many observations were made and how many species were identified during the CNC. Go to the [iNaturalist City Nature Challenge 2018 project](#) and check out results at a high level and record: total number of participants, observations, species, identifiers. Students will explore the results for their selected cities in a following section when they fill out a worksheet.

Explore

Explain to students that they are going to “dig into” the CNC results and present the results of the CNC from their cities across the world. In small groups representing each city, have students work through worksheet. Students can answer all questions, or modify for your class.

Explain

Each group should create a poster from their worksheet and presents to the class – set presentation time depending on the number of cities covered. Give students structure for the poster depending on which parts of the worksheet they complete. **Alternative:** Have students hang posters around the room and do a gallery walk where students visit posters and look for similarities and differences among the findings from cities.

Elaborate/Evaluate

Have students tally up the number of observations, species and contributors across the CNC to see the impact of this project. Have students use their pie chart for the proportion of species observed in their cities. Compare this to the global species pie charts from [Activity 1: Introduction to Biodiversity](#). How does it compare with iNaturalist observations and with scientifically described species?

After exploring this national event, what are your impressions of citizen science?

Modifications

This activity outlines one potential way to organize a data exploration. There are many ways to modify this for your class. For example, if you use Google Earth in class, you can have students calculate the area of their city.

City Nature Challenge: City Data Exploration Worksheet

Work through these questions using iNaturalist to explore the data collected across US cities for the 2017 City Nature Challenge. Visit the full [participating city list here](http://citynaturechallenge.org/city-list/), with links to each individual project: <http://citynaturechallenge.org/city-list/>.

Choose from the list of participating cities:

North America		South America	Europe	Asia
Amarillo, TX - USA	Los Angeles County, CA - USA	Bogota, Colombia	Cadiz, Spain	Ahmedabad, India
Austin, TX - USA	Lower Rio Grande Valley, TX - USA	Buenos Aires, Argentina	Barcelona, Spain	Hong Kong SAR, China
Baltimore, MD - USA	Maui, HI - USA	Campo Grande, Brazil	Berlin, Germany	Klang Valley, Malaysia
Bangor, Lewiston, Portland, ME - USA	Miami, FL - USA	Curitiba, Brazil	Bristol + Bath City, UK	Mumbai, India
Boston Area, MA - USA	Minneapolis - St. Paul, MN - USA	Florianopolis, Brazil	Guimarães, Portugal	Tokyo, Japan
Boulder, CO - USA	Monterrey, Mexico	La Plata City, Argentina	Madrid Area, Spain	
Charlottesville, VA - USA	Nashville, TN - USA	Manaus, Brazil	Padova, Italy	
Chicago Wilderness Region, IL - USA	New York City, NY - USA	Rio de Janeiro, Brazil	Plymouth, UK	
Cleveland, OH - USA	Omaha Metro, NE - USA	Salvador, Brazil	Prague, Czech Republic	
Dallas-Fort Worth, TX - USA	Pittsburgh, PA - USA	São Paulo, Brazil	Rome, Italy	
Denver Area, CO - USA	Raleigh, NC - USA		Sevilla, Spain	
Duluth Area, MN - USA	Richmond, VA - USA		Antarctica	
El Paso, TX - USA	San Antonio, TX - USA		Palmer Research Station	
Cabarrus County, NC - USA	San Diego County, CA - USA			
Hermosillo, Mexico	San Francisco Bay Area, CA - USA			
Houston, TX - USA	Seattle Area, WA - USA			
Indianapolis, IN - USA	Southern Oregon, USA			
Lake Charles, LA - USA	St. Louis Area, MO - USA			
Wasatch Front, UT - USA	Tulsa Area, OK - USA			
Vancouver, BC - Canada	Washington, DC - USA			
Waterloo, ON - Canada				

Now, using reliable sources, research the following to get an idea of the landscape, population, and wildlife that may be found in that city's area. Be sure to cite where you found the information in each section:

CNC City:
City population or metro area population
Climate information: average temperature, precipitation, for the year and for April
Weather conditions for city between April 14-18, 2017
Geological and hydrological features: landforms, rivers, lakes, ocean, elevation
Dominant biotic communities or dominant vegetation of areas (desert, forest, etc.)
Sources

Go to the iNaturalist project for the focal city (before the CNC) and investigate:

- Presence of parks and open spaces in urban areas

- Estimate size of CNC area (if possible)

- List some things you think are similar and different between your city and Boston from your research on climate, topography, population, etc. Which city do you expect will have more observations and more identified species? Why?

After the City Nature Challenge, you will go back to the city’s iNaturalist page and examine the observations more closely. You will be using the filters to search for different organisms. If you need a refresher on how to use iNaturalist to search and filter for observations, see the iNaturalist introductory lesson or this [“Getting Started/Exploring Observations”](#) page.

Look at the spread of data points across the CNC area and answer the following questions:

Are points spread evenly across the area or concentrated in certain areas? Can you tell where organized events were held?

Does the project include observations from the different landforms and water features you identified?

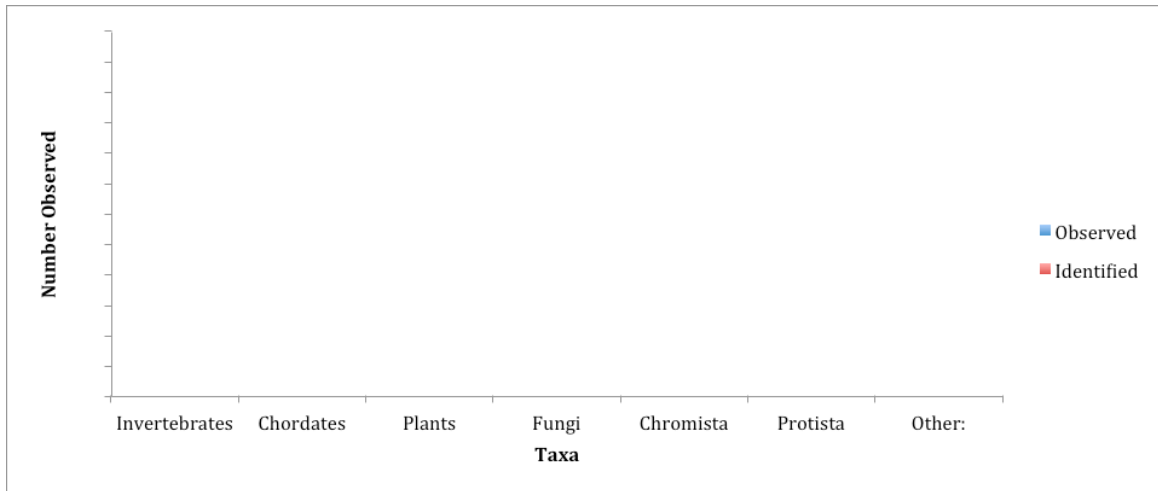
View terrain map. Are observations concentrated mostly in green spaces/parks, or does it appear there are many “backyard” observations?

City Statistics Summary:

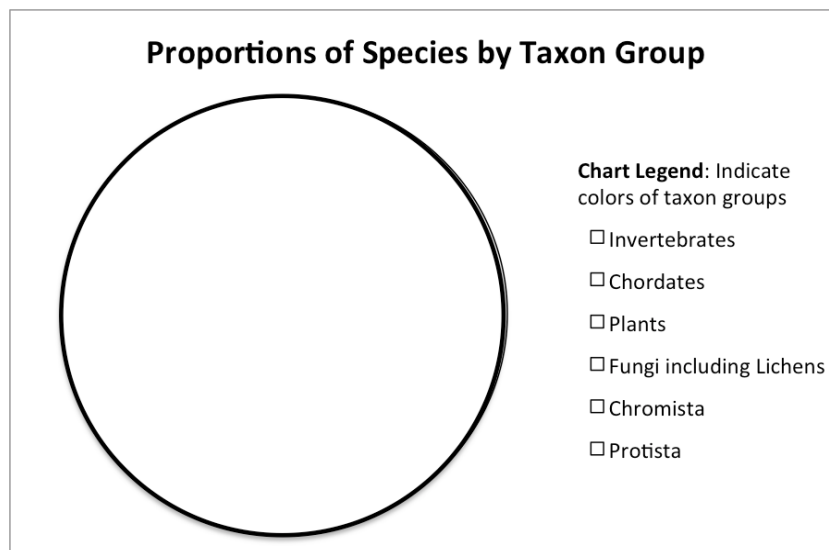
- Number of Observations
- Number of Species identified
- Number of Observers
- Number of Identifiers
- Top 5 species:
 - 1.
 - 2.
 - 3.
 - 4.
 - 5.
- Which user had most observations? Most identifications? What were those numbers?
- Visit the top user's iNaturalist profile. Can you learn anything about them?

In the CNC project for your city, filter for different taxon groups: plants, fungi, invertebrate animals (or break down into smaller groups), fish, amphibians, reptiles, birds, mammals. Make a graph for the number of observations and number of species for each group.

Taxon Group	Number of Observations	Number of Species Identified
Animals: Invertebrates		
Animals: Chordates		
Plants		
Fungi including Lichens		
Chromista		
Protista		



Using the data from the previous graph and table, create a pie chart to compare the proportion of species observed in your city area. Compare this to the pie charts we analyzed in the Introduction to Biodiversity activity.



What is a species you found in the observations that you've never heard of?

Were there any microorganisms observed (protista, bacteria, chromista)? Where were they observed?

What was your favorite organism observed in the city you chose? What was your favorite organism observed in your local city?

Adaptations (optional)

Search through observations to find 2 examples of organisms that live in both Boston and your city. What are their geographic ranges? What characteristics or behaviors do they have that allow them to live in both places? Use species pages on iNaturalist or EOL (eol.org) or other resources to find this information.

Find examples of 2 organisms from your research city that are not found in your area. What adaptations does each organism have to allow it to thrive in its environment but not in your area?

Rare and Endangered Species (Optional)

Using the filters for your city project, check the box for “threatened” species. How many threatened species were observed? Search through and choose a few to highlight, at least one plant and one animal. Search Encyclopedia of Life (eol.org) and other web sources to research what impacts the populations. Looking at maps of the area, do you see any evidence of what might cause the decline? Where was the organism found?

Invasive/Introduced Species (Optional)

Uncheck the “Threatened” box and check the “Introduced” box.

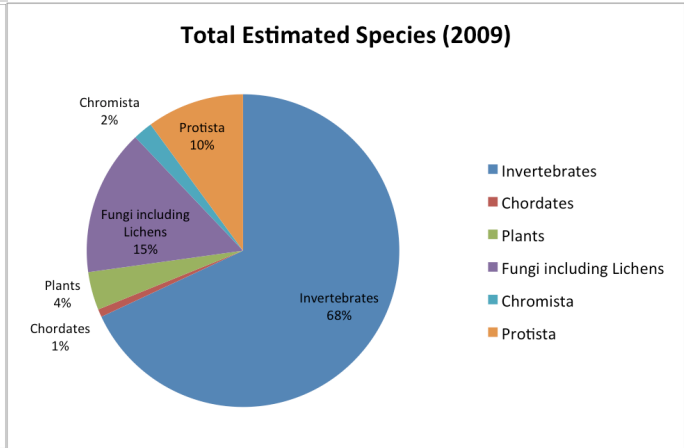
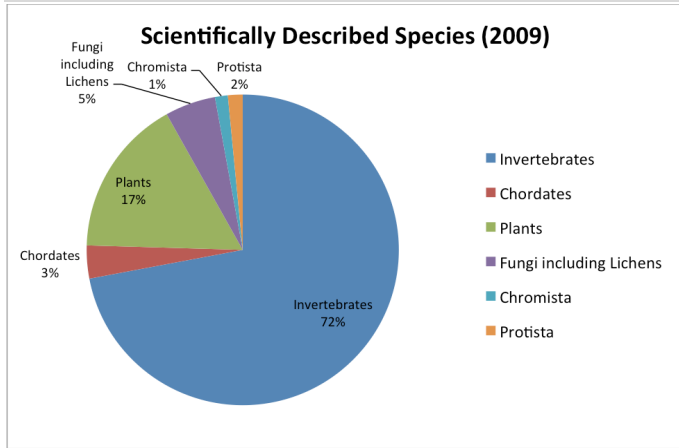
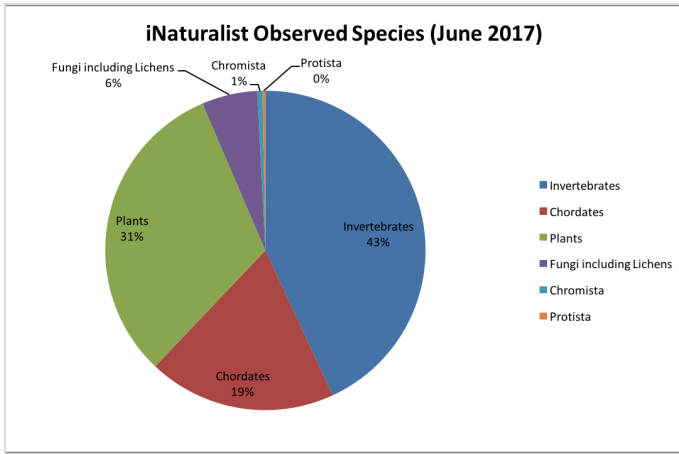
1. How many introduced species were observed?
2. In what taxa did you see the most observations of introduced species?
3. Which introduced species was observed most frequently? Search through and choose a few species to highlight, at least one plant and one animal.

Search Encyclopedia of Life (eol.org) or other trusted resources to find organism’s original range and introduced range. If you can, find information about the native species they compete with, and see if you find observations of the native species.

Reflections

- What are your impressions of citizen science after exploring data from this large-scale national bioblitz? How did it make you feel to contribute to iNaturalist?
- What do you think some of the benefits and challenges of including the public in the scientific process?

For Chart Comparison Activities



Next Generation Science Standards

Performance Expectations

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales
- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Science and Engineering Practices

- Asking Questions and Defining Problems
- Planning and Carrying Out Investigations
- Analyzing and interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating and Communicating Information

NGSS Nature Of Science Principles (Appendix H) with clarification for 9-12

- Scientific Investigations Use a Variety of Methods
- Scientific Knowledge is Based on Empirical Evidence
- Scientific Knowledge is Open to Revision in Light of New Evidence
- Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science is a Way of Knowing
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science is a Human Endeavor
- Science Addresses Questions About the Natural and Material World

