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City Nature Challenge: iNaturalist Data Exploration

Grades: 9-12 Time: 60 minutes Location: Classroom

Big Ideas/Themes

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

Essential Questions

- How did our observations from Boston 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?
- Have your impressions of scientists or citizen science changed through the CNC?

Objectives

- Students will **compare/contrast** observations in different cities in the CNC
- Students will **practice** basic scientific skills such as data analysis, forming 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 CNC cities (home)
2. Explore results of CNC in other cities- optional adaptations and conservation questions (30 min)
3. Create and share posters of their city results, comparing to Boston (25 min)
4. Discuss iNaturalist, CNC, and the value of participating in citizen science (5 min)

Directions

Preparation

Assign or have students choose a city they would like to compare with Boston. Try to cover every city or choose cities from different parts of the country (maybe not New York, or choose one city in Texas.) 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)
- What are some hypotheses they have about the number and kinds of species that will be observed in the area compared to Boston? Similar? Different? Why?

Record statistics of observations, species, and number of observers within the Greater Boston area (and other cities if possible) before CNC. This way, you can track how many new observations, how many new species, how many new observers/identifiers engaged in this event. After the CNC, calculate a class total to see the IMPACT. You can also use the filter function on iNaturalist to filter for specific times and date ranges, after the fact.

Engage

Discuss the City Nature Challenge:

- What did students find?
- What was the favorite organism they observed?
- What's something they saw that surprised them?
- Were they expecting to find more or less organisms?

Have students guess how many observations were made and how many species have been identified so far during the CNC. Go to the Boston iNaturalist City Nature Challenge project and check out results at a high level and record: total number of participants, observations, species, identifiers. You can check the Natural History Museum of Los Angeles: City Leaderboard if you want to peak at the current standings (between April 14-21, 2017) or look at final tallies nationwide after winners are announced on April 22, 2017 (Earth Day). 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 other cities across the country. In small groups representing each city, have students work through worksheet. Students can answer all questions, or modify for your class.

Explain

Each group creates 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 participating in the CNC, what are your impressions of citizen science? How do you feel knowing that you helped contribute to such a large project?

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 during the City Nature Challenge (CNC).

Before the City Nature Challenge: choose from the list of participating cities:

Northeast + Mid Atlantic	South	Midwest	Mountain West	West Coast
Boston, MA	Triangle Area, NC	Twin Ports, MN	Salt Lake City, UT	San Francisco, CA
New York, NY	Miami, FL	Minneapolis, MN		Los Angeles, CA
Washington, DC	Nashville, TN	Chicago, IL		
	Houston, TX			
	Austin, TX			
	Dallas-Fort Worth, TX			

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:

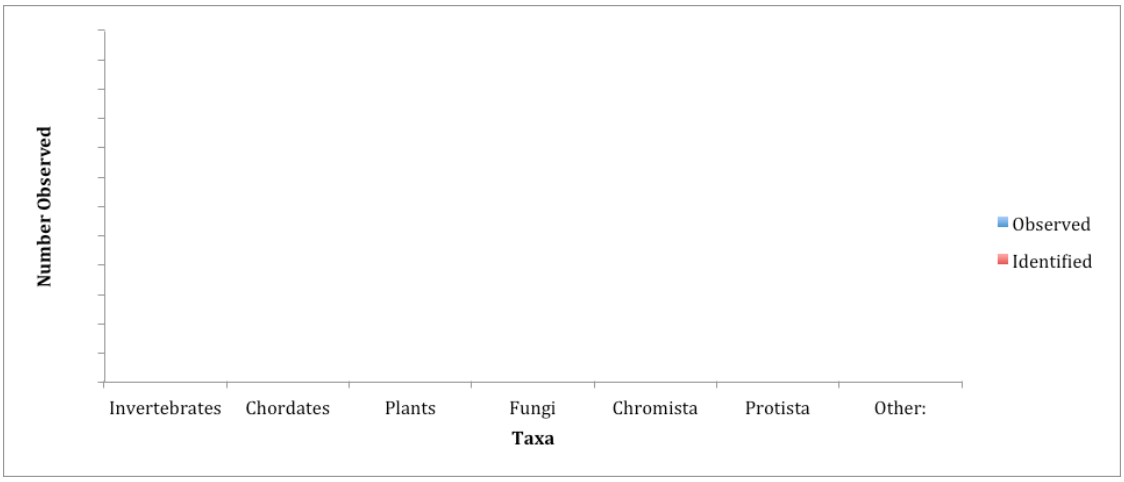
Are points spread evenly across the area or concentrated in certain areas? Can you tell where organized events were held?
Does the project include observations from the different landforms and water features you identified?
View terrain map. Are observations concentrated mostly in green spaces/parks, or does it appear there are many “backyard” observations?

City Statistics Summary:

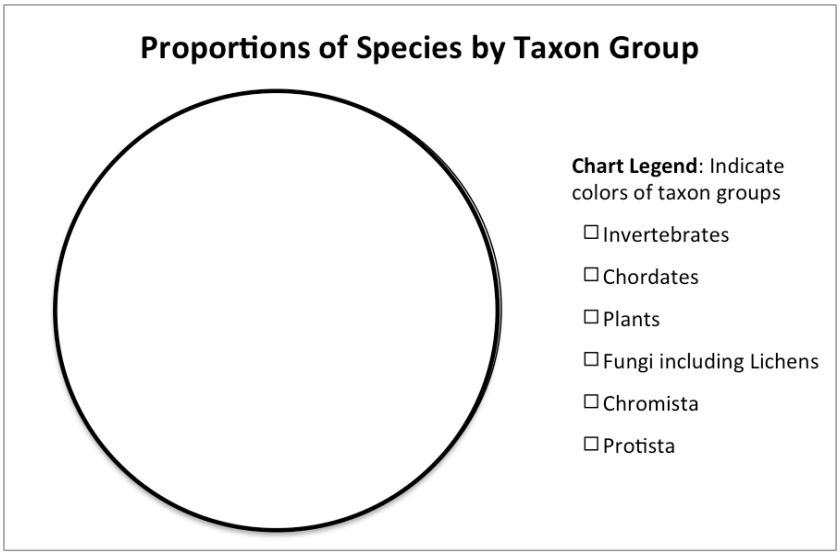
- Number of Observations
- Number of Species identified
- Number of Observers
- Number of Identifiers
- Top 5 species:
  1.
  2.
  3.
  4.
  5.
- Which user had most observations? Most identifications? What were those numbers?
    - Visit the top user’s iNaturalist profile. Can you learn anything about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

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 city that are not found in Boston. What adaptations does each organism have to allow it to thrive in its environment but not in New England?

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.

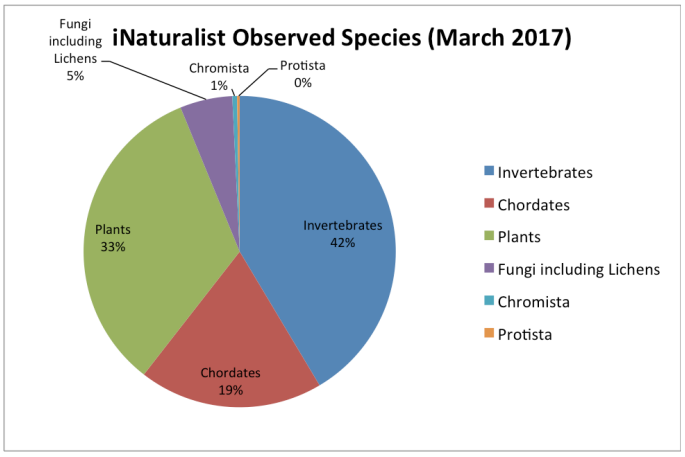
Search Encyclopedia of Life (eol.org) or other trusted resources to find organism’s original range and introduced range. If you can, find information about the native species they compete with, and see if you find observations of the native species.

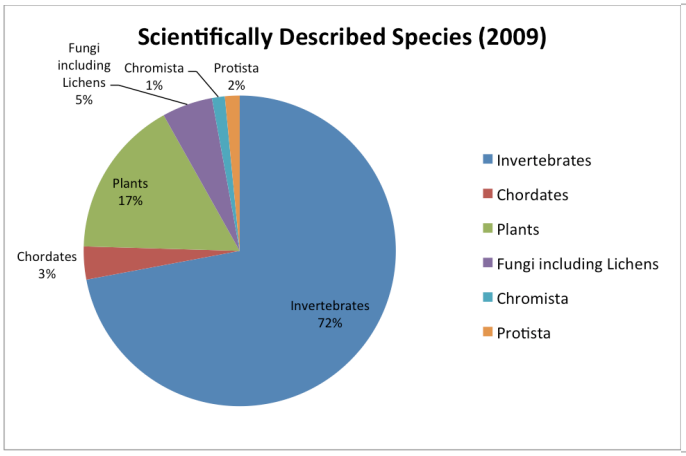
Reflections

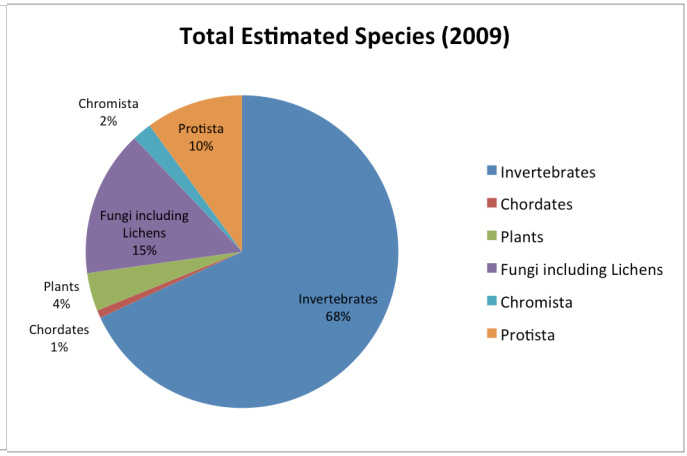
- What are your impressions of citizen science after participating? How did it make you feel to contribute to a citizen science and open science platform?

- What do you think some of the benefits and challenges of including the public in the scientific process?

For Chart Comparison Activities







Massachusetts and Engineering

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Science, Technology, Standards

LS2 - Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem.
- HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience.
- HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

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LS4: Biological Evolution: Unity and Diversity

- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence, including molecular, anatomical, and developmental similarities inherited from a common ancestor (homologies), seen through fossils and laboratory and field observations.
- HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species, the emergence of new species over generations, or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.

ESS3 - Earth and Human Activity

- HS-ESS3-1. Construct an explanation based on evidence for how the availability of key natural resources and changes due to variations in climate have influenced human activity.
- HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Science Practices (MA STE)

- Asking Questions and Designing Problems

- Developing and carrying out investigations
- Analyzing and Interpreting Data
- Communicating Evidence

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