



## Lesson: Investigating Biodiversity

# iNaturalist Data Analysis

## Key Question

How can we investigate patterns and relationships in biodiversity using iNaturalist?

## Objectives

- Students will **explore** local observations using iNaturalist
- Students will **investigate** and **analyze** data using iNaturalist data filtering and export features
- Students will **draw inferences** about the patterns among organisms at different scales

Grade: 9-12 Biology

Time: 90 minutes

Location: Classroom

## Materials

Computers with internet access  
Journals/notebooks  
Butcher block paper or white board  
Data sheet (attached)

## Culminating Activity

Students will explore iNaturalist data and use data to design and carry out investigations in small groups. Students will present findings to the class.

## Directions

**Note: This activity focuses on specific projects and locations on iNaturalist as an example. It can be modified to cover any geographic location or scale.**

### Engage/Explore iNaturalist (15 minutes)

Guide students through the features of iNaturalist. You can demonstrate this in front of students on projector or have students follow you on their own computers.

1. Go to [iNaturalist.org](http://www.inaturalist.org). Click on “Observations” to see the map of the world with tallies of total number of observations, number of species identified, and number of users. The iNaturalist site is a global community of naturalists who share information about biodiversity. This effort is very powerful and demonstrates how citizens can help contribute a huge amount of meaningful scientific data that scientists may not have the resources to collect.
2. In Projects drop down, search “2016 Brandeis Bioliteracy Challenge” (<http://www.inaturalist.org/projects/2016-brandeis-bioliteracy-challenge>). This project was started as part of Biol17B Conservation Biology course to increase student bioliteracy. The goal of this challenge for students interested in conservation to push themselves to learn more about the species they interact with everyday. Check out the top observers and species.

3. Demonstrate how to navigate observations. Have students click on the “Observations” button in the green Totals box on the left side of the screen. Show students how to toggle between the different views of observations: map, list, and icon.
4. Introduce students to the search filter. Show students how to search for a taxon and a place. Review taxon group icons and checkboxes for threatened and introduced species. Show students an example of filtering for a particular group, for example birds, then click “Update Search” to show all birds in the results. What are some of the data that each of these observations hold: location, timestamp, identification, sometimes specific information (male/female, age, etc.).
5. Show students how to zoom in and out on the map and click “redo search in map” to update results.
6. Optional: Explain that students can also download data via Microsoft Excel. If you choose to use excel, demonstrate to students how to choose the appropriate number of columns when choosing data (basic identification, time, geographic, taxon information, observation fields).

**Explain (10 minutes):** Give students time to brainstorm questions that are appropriate for investigation using this data. Give students some examples of these:

- What are the seasonal patterns of Gulf Fritillary butterflies as observed by iNaturalist users?
- What percentage of plants observed in Massachusetts are invasive or introduced?
- What are the differences in vertebrate species abundance in Boston vs. Phoenix, Arizona?

Students should share out ideas for investigations they would like to do using the iNaturalist data from a local project and beyond. Review questions and come up with 4-5 appropriate projects or modify questions.

There are endless questions that could be investigated using iNaturalist data and field observations. Today, we will investigate the following questions:

- How do the number of observations and number of species change over different geographic scales?
- What inferences can be made from the primary observations about changes in biodiversity composition and richness?

**Elaborate (45 minutes):** Explore Data

We will investigate observation data from three different geographic scales in iNaturalist.

1. First, search for the 2016 Brandeis Bioliteracy Challenge project. Click the “observation” tab on the left-hand side of the project page. Filter for the number of observations and the number of species for plants by clicking the plant icon and ensuring the “verifiable” box on left-hand side is selected. Click “Update Search” and record numbers in the table provided.
2. Repeat for the following taxa: fungi, birds, mammals, amphibians, reptiles, fishes, and insects. You can also search other taxa by either clicking additional icons (mollusks, arachnids, Chromista) or using the “search” bar outside of Filter.
3. Go to the observations tab in iNaturalist (outside of the project), which should take you to a world map filled with observations. Click the “Filter” button next to the search bar and click the “More Filters” link on the bottom left corner to display additional fields. Type in “Middlesex County, MA” in the Place field and select from the drop-down menu. This will limit all

observations to within the county. Assure that the “verifiable” box is selected. Click the plant icon and “Update Search” to display the number of observations and species for that taxon in Middlesex County. Record numbers in table. Repeat for all taxa.

4. Repeat this at larger geographic scale: Massachusetts.
5. Have students spend 15 minutes analyzing data and discussing and answering the research questions.

**Evaluate (20 minutes):**

Lead a discussion to address the following questions:

- What inferences did you draw from primary observations about changes in biodiversity composition and richness across geographic scale?
- What do you think may be the causes for observational differences at different scales?
- What are the opportunities and limitations of using data from iNaturalist vs. data from research or other citizen science projects to answer questions?

**Modifications/Extensions**

- Incorporate a mini-bioblitz or short, focused field investigation to this so students contribute to iNaturalist project as well.
- For a simplified version of this activity, modify the National Geographic Education “Analyzing Bioblitz Data” (<http://nationalgeographic.org/activity/analyzing-bioblitz-data/>) activity

**Educator Key/Cheat Sheet**

	Brandeis Project		Middlesex County		Massachusetts		Global Estimates (Chapman)	
Taxon	Observations	Species	Observations	Species	Observations	Species	Scientifically Described	Estimated
<b>Plants</b>	354	94	2,935	556	10,151	1,173	297,800+	390,800
<b>Fungi</b>	2	2	262	73	2,306	399	99,000 (17,000)	1.5 million (25,000)
<b>Birds</b>	175	36	3,178	201	5,845	310	9,900	10,000
<b>Amphibians</b>	0	0	103	11	616	17	6,500	15,000
<b>Reptiles</b>	4	2	161	10	420	23	8,700	10,000
<b>Mammals</b>	57	9	344	24	846	43	5,487	5,500
<b>Fishes</b>	1	1	10	6	144	65	31,000	40,000
<b>Insects</b>	24	12	2,498	505	12,513	1,987	1,000,000+	5,000,000

Estimates gathered from: Chapman, A. (2009). Numbers of living species in Australia and the world (2<sup>nd</sup> ed.).

## 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-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

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



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