

Overview

At LabVenture and in previous lessons, students have explored how temperature is changing over time, both in the ocean and on land. However, climate is determined by more than just temperature. In this lesson, students will explore how precipitation (rainfall) is changing over time in Maine and what impacts those changes might have on the spread of Lyme disease.

Estimated Time

45 minutes (1 class period)

Target Student Learning Outcomes

Data and Scientific Inquiry (This is the work that scientists do!)

- Data help us understand a problem or phenomenon and can be used as evidence to support scientific claims.
- Data can be represented and organized in different ways in order to answer different questions or reveal new information.
- Using data to understand a phenomenon involves being able to read and make sense of data representations (tables, graphs, maps, etc) and models.

Standards

NGSS

- Science & Engineering Practices
 - 4. Analyzing and Interpreting Data
- Crosscutting Concepts
 - 7. Stability and Change

Common Core

- Standards for Mathematical Practice
- CCSS.MATH.PRACTICE.MP3: Construct viable arguments and critique the reasoning of others.

Vocabulary

humidity, precipitation

Preparation

- Read this entire guide to familiarize yourself with the flow of the lesson.
- Do the online activities as a student so you will be prepared to help students if they get stuck.
- Prepare to share Student Sheet: Lesson 4 ([Google Doc](#) or [Print](#)) with students. Remind students about the [Glossary](#).
 - The Google Doc link will prompt you to make a copy to your own Google Drive. This will allow you to edit the document and/or share editable copies with your students. Note that in the Google Doc version of the Student Sheet, response boxes are formatted as table cells that will automatically expand to fit entered text.
 - If you use Google Classroom, you can create an assignment and **Make a copy for each student** so that students receive an individual copy of the file that they can complete online.

Possible Misconceptions and Barriers to Learning

- **Trends:** When discussing trends and trend lines, be sure students understand that this is not the same as connecting the dots between data points, nor is it picking points at either end of the data set and drawing a straight line between them. For the purposes of these lessons, a trend describes the overall direction of change of a time series graph. As you go forward in time, do the data values get bigger, smaller, or stay about the same?

Facilitating the Lesson

Introduce the lesson.

Provide students with a brief (~ 5 minute) introduction to the lesson and the goals for the day. Here is a sample script you might follow:

"In the last lesson we learned the number of days with a minimum temperature, remember that means the coldest temperature of the day, above 45 degrees Fahrenheit is increasing for both Lincoln and Aroostook counties. The spread of Lyme disease in Maine is very complex, however we know that ticks are most active in seeking a host, like a mouse, deer, one of our pets, or even us, when daily temperatures are above that 45 °F value.

Scientists are still actively investigating what other climate and ecosystem factors affect tick survival and questing behavior. One other climate factor scientists think is important for ticks is precipitation, which we experience as rainfall or when it's cold enough, snow.

You're going to work online [with a partner or in a small group]. Your goals for today are to:

- Understand why rainfall and humidity are important for ticks.
- Use data tables, and graphs to answer different questions about how the days with rainfall are changing over time in Lincoln and Aroostook counties.
- Consider how the number of days with rainfall is affecting ticks and Lyme disease in Lincoln and Aroostook counties.

When you get to your computers, go to the LabVenture website and open [Ticks & Lyme Disease Lesson 4: Rainfall](#).

Make sure you read all the instructions carefully before you start clicking around. There will be some questions on the screen for you to answer. Some are just questions to think about or discuss with your partner [or group] and others require you to provide an answer. There will also be new vocabulary words. Words that are orange are defined in the Glossary for this lesson.

I'll be walking around the room to help you if you get stuck. When you get to the page that says 'Stop,' wait for instructions from me before moving on."

Have students complete the online activities.

- It is recommended that students work in pairs or small groups to complete the online activities.
- While students are working, walk around the room to troubleshoot and answer questions. Below is an outline of the work students will be doing in each of the online activities. Big ideas are listed for each activity. Suggestions for stopping points and discussion prompts for key moments of reflection and synthesis of learning are also provided.

1. Hydration is key

Students learn why humidity and rainfall are important for tick survival and questing.

Big Ideas:

- Ticks can't drink water, but need hydration to survive. This comes from moisture in the air as humidity or from the ground on rain soaked leaf litter.
- Ticks like it warm, but if it's too hot and too dry, ticks will seek hydration rather than a host.

Facilitation Suggestions

- Students may be unfamiliar with humidity or may have only heard this term used a few times. Anchor their understanding in their experiences with Maine summers, which are often humid or "muggy".

2. How are moisture levels impacting the spread of Lyme disease?

Students explore the number of spring/summer (May through August) days with rainfall for the years 1982 to 2018 in Lincoln and Aroostook Counties. Days with Rain is used as a measure of wetness during the crucial tick questing months. Students create a dot plot to compare the distribution of the number of spring/summer days with rain in Lincoln and Aroostook counties.

Big Ideas:

- Spring and summer are when ticks are most likely to be questing and need humid conditions to stay hydrated. When it rains, humidity is 100%. Spring/summer rainfall data can be used to find out how suitable the humidity conditions in Lincoln and Aroostook counties are for questing ticks.
- Aroostook County has more rainy days during the spring/summer tick questing months than Lincoln County.

Facilitation Suggestions

- Students may need help distinguishing which county has more rainy days using the dot plot. Have them consider the center of the distribution, or where the most points seem clumped together, for each county.
- Remind students that the plots for the two counties share the same x-axis scale (Rainy Days).

3. How is rainfall changing over time?

It's already wet enough for ticks to thrive in Lincoln County and it's even wetter in Aroostook County. But is climate in these two counties getting wetter, drier, or staying about the same over time? Students make graphs and draw trend lines to explore how the number of spring/summer days per year with precipitation is changing over time in Lincoln and Aroostook Counties.

Big Ideas:

- A trend describes the overall direction of change of a time series graph.
- The number of spring/summer days per year with rain in Lincoln County varies quite a bit, but the overall direction of the trend is slightly increasing.
- Despite a drought year in 2018, the overall direction of the trend in the number of spring/summer days per year with rain in Aroostook County is slightly increasing over time.

Facilitation Suggestions:

- Drawing and describing trends in time series data isn't always easy. Sometimes data values can change greatly from one year to another. This is called variability. The Days with Rain data sets have much more variability from year to year than other data sets students have worked with in this unit. This may make it harder for them to discern a clear trend over the whole time period for each county.
 - Students may be tempted to "trace" the data points with their drawings, but remind them they are looking to draw a trend for the *whole* time period, rather than smaller chunks of years.
 - Remind students that there should be about the same number of points above their trend line as below.
 - If students struggle with the Draw tool, suggest they try using the line tool to draw a linear, or straight line, trend.
- Students may notice a sharp drop in the Aroostook data for 2018 and a similar, but less severe, drop in the Lincoln data. This is because 2018 was a drought, or unusually dry, year for Maine.
 - Remind students that one year does not make a trend and we need to look at more years of data to determine if these counties are getting drier or if 2018 was just an unusual (outlier) year.
- It may be helpful to bring the whole class together to work through drawing the trend lines as a class. Example trend lines, explanations, and tips for facilitating discussion can be found in [Teacher Guide Supplement: Example Rainfall Trends](#).
 - Give students time to practice on their own before coming together as a group to come to a consensus on how to best draw a trend line for each county.
 - Seek input from as many students/student groups as possible.
 - Have students explain why they chose to draw the trend lines as they did.
- Have all students stop and await instructions before moving on to page 4. Because students are not logged in, their work will not be saved unless they follow specific instructions to capture their work before closing their browser or exiting the lesson (details below).

4. End of Lesson

Students Print or Share their work. Responses to the questions embedded in the online lesson will be useful for students to keep as notes for the lesson and to refer back to when completing Student Sheets. Collecting this work for assessment is optional.

Facilitation Suggestions:

- When students reach the page titled End of Lesson, have them click the Show All Answers button:

A rectangular button with a blue gradient and rounded corners, containing the text "Show All Answers" in white.

- Have students Print or Share their responses.

A rectangular button with a blue gradient and rounded corners, containing the text "Print" in white.

Clicking Print will open the Print dialog box and allow students to print a hard copy of their responses. They may also be able to print to PDF if your settings are configured to allow this.

A rectangular button with a blue gradient and rounded corners, containing the text "Share" in white.

Clicking Share will open a dialog box with a link that students can copy and paste into an email or document. This link can be used to re-open their answer sheet in a browser any time.

- Once their work has been printed or their link has been safely emailed or saved in a document, students can click Close to exit the lesson.
- Have students complete Student Sheet: Lesson 4 ([Google Doc](#) or [Print](#)).
- As a class or in small groups, have students share and discuss their answers to the questions on the Student Sheet. Questions you might ask:
 - What claims did you make about how the number of rainy spring/summer days per year is changing for Lincoln and Aroostook counties?
 - How did you describe the direction and steepness of the trends?
 - What evidence do you have to support your claims?
 - What data did you use?
 - How did you describe the shape of the graph?
 - Why did you draw them that way?
 - Who thinks the amount of rainfall in these counties will be suitable for ticks in the future? What evidence did you use to come up with your answer?

Wrap-up the lesson.

Close out the lesson by reminding students of where they started the day and previewing what's next. Here is a sample script you might follow:

"Today, we learned about spring/summer rainfall in Lincoln and Aroostook Counties and what that means for the spread of Lyme disease. To wrap up this unit, you're going to do a group project in which you create your own PSA (Public Service Announcement) about ticks and Lyme disease here in Maine. We'll go over the details at the beginning of the next lesson."