

# Syllabus for Principles of Ecology (BIOL 203)

Spring 2023

Gregg Hartvigsen

version date: January 23, 2023

“Any fool can know. The point is to understand.” Albert Einstein

Course item	Details
Meetings	Tues/Thur 9:30 - 10:45 and 11:00 - 12:15, Schrader 1
Dr. H's contact info	ISC 360 (office); hartvig@geneseo.edu.
Office hrs	Mon. 4:00pm – 6:00pm (Zoom only, <a href="https://geneseo.zoom.us/j/4333683209">https://geneseo.zoom.us/j/4333683209</a> , passcode = 497118). Tues. 2:30 – 4:00pm, Wed. 2:00 – 3:00pm (only in my office).
TAs	Sarah Longuil and Abby Shafer
Textbook (free)	<i>The Science of Ecology</i> , Hartvigsen (2023). PDF on Canvas
Optional textbook	<i>A Primer in Biological Data Analysis</i> , 2nd ed. (Hartvigsen, 2021b) if you want more details for using <b>R</b>
Laptop computer (Mac or Windows, although Linux works for me)	A few times you will be asked to bring this to class. A Chromebook will not be sufficient to complete exercises in this class (see <a href="https://wiki.geneseo.edu/display/cit/Student+Laptop+Requirement">https://wiki.geneseo.edu/display/cit/Student+Laptop+Requirement</a> ).
Software (free)	<b>R</b> (version 4.2.2 or later), <b>RStudio</b> (version 2022.07.1 Build 554 or later), <b>Excel</b> or similar, and a PDF reader.
Cloud storage (free)	You are expected to keep all files from this class in a folder that <b>automatically</b> syncs in the cloud. This can be through “Google Drive” (recommended), Dropbox, OneDrive, or iCloud. This protects you from having to utter the words “I lost my work because my computer died.”
Calculator ( $\leq$ \$10)	It must be able to do $\ln()$ and $e^x$ . New batteries. You will be disappointed if your calculator is DOA at an exam.
Mask Policy: you must bring a mask <b>to all class meetings</b>	We'll do our best to be flexible. If case numbers are high or rising on campus I'll require masks to be worn. You must wear masks during group work when talking to each other (see Hartvigsen, 2021a).
Stapler	Your homework assignments must be stapled - not a set of loose papers.

**definition:** Ecology is the scientific study of the interactions between living things and their biotic and abiotic environments (Hartvigsen, 2023).

## 1 Overview

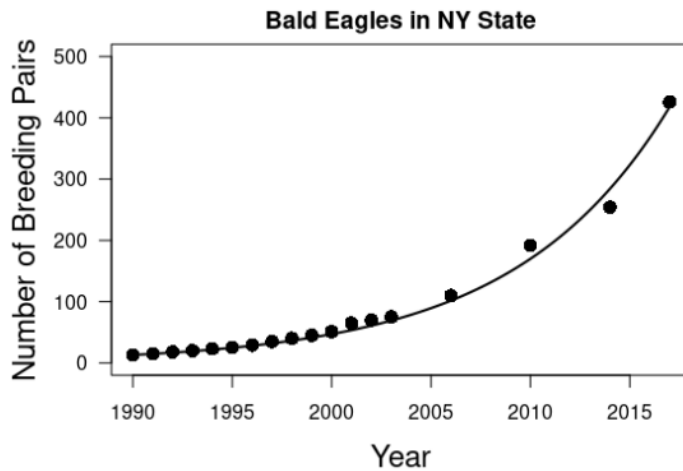
I will work to provide you an introduction to this broad area of science. If you read any news source you're likely to quickly find an ecological challenge facing humanity, such as global climate change, the extinction risk of a species, human conflict over limited resources, or the emergence and spread

of an introduced species or even human disease agent (e.g., SARS-CoV-2). All of these are problems of ecology. My goal is to help you enhance your interest and understanding in ecology and gain the ability to better assess scientific information.

As a heads up to you I received this on a recent SOFI: “Hartvigsen just shows data and math and nothing else.” Well, that’s not true but it might seem that way. Below it’s nice to recognize that the image is of a bald eagle (*Haliaeetus leucocephalus*) but you probably knew this. Now it’s time to ask, and answer, more complicated questions like “how is the population changing?” “Is it’s rate of increase *significant* (which means it’s different than just bouncing around randomly)?” “If it’s changing, what is the *annual rate of change*?” And “can we predict what the population will be in the future?” These questions are answered with data, math, statistics, and an understanding of the principles of ecology. The answer is that the number of breeding pairs is increasing exponentially in NY State. And, instead of asking you to believe me, I support this conclusion with a beautiful graph and some objective math and statistics ( $F = 3656$ ;  $df = 1, 16$ ;  $p < 0.001$ ;  $R^2 = 0.9954$ ;  $N_t = 13 * e^{(0.1285 \cdot (yr-1990))}$ ). That’s about 13.7% year<sup>-1</sup> since 1990! Note that  $e^{0.1285} = 1.137$ .



Eric Frommer, Creative Commons



Ecologists might be accused of missing the beauty of nature, such as the bald eagle, by reducing it to some numbers. I hope you see that, as an ecologist, you are able to enjoy the beauty of nature just as well as any poet or artist. However, knowing more about it, such as the evolutionary history, the role the eagle plays in food webs, and how the number of breeding pairs changes over time, greatly extends one’s appreciation of nature, and does so far beyond what any poet or artist can enjoy.

## 2 Expected Learning Outcomes

If you work effectively and succeed in this class you can expect to be able to:

1. **explain** how ecologists use the scientific method to derive evidence-based understanding and prediction of ecological phenomena;
2. **explain** a variety of patterns in nature using a broad array of ecological principles, including how organisms deal with the physical environment, how species evolve over time, particularly

via the process of natural selection, how the sizes of populations change over time, and how species interact with each other;

3. **apply quantitative methods**, particularly using the **R** statistical and programming language and mathematics, to achieve better understanding and predictions of ecological systems;
4. **correctly interpret** scientific information, particularly when presented graphically;
5. **explain** your role, and humanity's role, in affecting the environment through your use of natural resources;
6. **explain** the role of ecology in our pursuit of environmental justice;
7. **correctly explain** the difference between evidence-based information from evidence-free conspiracy theories, beliefs, and opinions;
8. **actively engage** with fellow students in discussions involving ecological principles.

### 3 Resources

1. **Dr. H.** Please recognize that I am a member of your academic success team. It's not you against me. It's you and me working to understand the principles of ecology together. I do write the assessments so you should ask me how I do it (and read about this below in section 6 on page 8). If you have questions join me during office hours.
2. **Teaching assistants Sarah and Abby.** These folks are available to help you succeed on the Ecological Applications assignments. They have successfully completed Principles of Ecology and were TAs last semester so are experience. They are adept at using **R** to solve problems. Their responsibilities do **NOT** include general help with lecture material or the Ecological Exploration exercises, although they have said they like trying to answer these questions. Officially, your answers should come from me since I write the assessments.
3. **This syllabus.** It's long and detailed. It has dates, expectations, helpful advice, and guidance for assignments. It is meant to help *you* succeed.
4. **Lectures.** These are generally important to catch. I try to present information that will be useful to you (on the Assessments and instructions for assignments). Not everything will be on the exam – there's too much. I will work to provide on Canvas “pre-lecture notes” that you can pull up at the beginning of class. There will be “post-lecture notes” within 24 hrs (if not, send me an email!). The slides are **NOT self-explanatory**. They will mostly only make sense if you attended the lecture. Recent SOFI: “The [post-lecture note] slides don't have any words on them so they don't make sense if you miss lecture.” Fortunately, there's the next item:
5. **Textbook.** The latest draft of The Science of Ecology is available on Canvas. Note the textbook has three appendices supplying help with **R**. There's a fourth that lists “Principles of Ecology.” You're responsible for those.

Here's how to get the textbook: In Canvas click on the three vertical dots and download the textbook. Canvas often fails to load it because it is a large file.

6. **Office hours.** These are times set up so I can help you. If you're having trouble others are probably have challenges, too. Join us.
7. **Software.** Here are the software programs you'll need to succeed in this class. All are free. If you already have **R** and/or **RStudio** then install the latest versions of these – they change monthly.

- (a) Excel (or a look-alike). Free for matriculated students.
  - (b) **R**. Free. Go to <http://cran.case.edu/> and get the version for your computer.
  - (c) RStudio. Free front-end for **R**. Install after you install **R**. Go to <https://www.rstudio.com/products/rstudio/download/#download> and choose the version for your operating system under the “Installers for Supported Platforms” heading.
8. **Fellow students**. During class you’ll be given opportunities to work with neighbors to discuss questions posed during class. Hopefully you’ll make some connections that might lead to study partners. You don’t have to interact with anyone if you don’t want to - this is up to you and you may ignore my encouragement to mingle.
  9. **Email**. You are responsible for information provided to you via your Geneseo email account from me. This is the most effective way to reach me outside of office hours. Note that you **must use** only your @geneseo.edu account when sending me an email. Otherwise your message may be marked as spam and I may not get it. I do not check my spam. Do **NOT** use email within Canvas - I do not check that!
  10. **Past assessments**. Every assessment I’ve given in this class since 1998 is available in my Geneseo “Outbox.” For help on finding boxes see <https://wiki.geneseo.edu/display/cit/Inboxes+and+Outboxes>.
  11. **“What’s new?”** Each lecture begins with this question. Please check out the news and share. Here are several great sources:
    - (a) <http://www.sciencedaily.com/>,
    - (b) <http://www.sciencemag.org/news>,
    - (c) <http://www.nature.com/news/>,
    - (d) <https://www.nationalgeographic.com/latest-stories/>.
    - (e) <https://www.livescience.com/>.
  12. **Additional SUNY Geneseo resources**. See <https://wiki.geneseo.edu/display/PROVOST/Syllabus+Resources+Related+to+Student+Success>.

## 4 Grading stuff

The following table shows the breakdown for points.

Item	Number	Points for each	Total pts
Ecological Explorations (EE)	3	10	30
Ecological Applications (EA)	3	20	60
Assessment 1	1	20	20
Assessment 2	1	40	40
Assessment 3	1	60	60
Total			210

“Ecological Explorations” (EE) are shorter homework assignments (see section 5.1 for details). “Ecological Applications” (EA) are longer homework assignments that are quantitative applications of data and/or models to understanding ecological principles (see section 5.2 for details). All assignments are due at the beginning of class. These accrue a late fee of 5 pts per 24 hrs late. If you can’t

make it to class that day provide a evidence of an official excuse (e.g., from Lauderdale) and email the assignment as a pdf before class begins. I will not accept a Google Doc link - you must send the document as an attached pdf. Note: **Printers are usually down right before class** so plan ahead. Printing 5 minutes before class represents extremely risky behavior. We will spend ~10 minutes or so discussing in groups what you found.

## What’s my grade in this class?

Your grades will be maintained in Canvas. The grades for assessments are usually up in two or so days. The “Explorations” and “Assessments” usually come back during the next class meeting. They’ll have a rubric attached letting you know how you did. I go over the assessments in detail the day they are handed back. Ecology Application assignments take about a week to return. If you miss the classes when things are handed back you may have to catch me in my office to pick it/them up. **It is your responsibility to ensure those scores are accurate. You have one week after an assignment has been returned to contest a grade.**

I will use the following relationships to translate the proportion of earned points into letter grades:

Score		Letter Grade	Score
0.933	≤	A	
0.900	≤	A-	< 0.933
0.867	≤	B+	< 0.900
0.833	≤	B	< 0.867
0.800	≤	B-	< 0.833
etc.			

Note that I will round your proportion of points earned **UP** to three decimal places using Excel’s function `CEILING(number, 0.001)`. The college rounds grades **DOWN** (truncates) when calculating your GPA. See the worked example in the Bulletin which shows a student getting 38.2 “quality points” in 14 credit hours of course work. That should be 2.728571 but they *truncate* that to 2.72. To help counter this injustice I will take a grade of, say, 0.832105, which would be a B-, and round it up to 0.833, making it a B.

## 5 Homework Assignments

### 5.1 Ecological Explorations (EE, 10 pts each)

These are assignments that are planned as two-part experiences. The first part involves completing the assignment which you bring, printed out, on the day each is due (see schedule in section 7). The second part of the assignment involves sharing in groups what you found. Note: these must be printed out responses, not hand written.

### 5.2 Ecological Applications (EA, 20 pts each)

We will explore a few in-depth applications of methods used by ecologists in this class. These include working with data and modeling. Galileo is attributed as saying that Nature is written in the language of mathematics. We are studying nature and it is best understood using quantitative

approaches. Fortunately, you've been studying mathematics for years and this will help you understand complex biological systems. In particular, these applications are designed to help you explore Nature more deeply.

If you find computer programming, math, and/or statistics intimidating and/or challenging recognize this about yourself and plan accordingly. In this class we will see data and output from models daily. These application exercises, however, are opportunities for you to gain this fundamental skill in science.

### 5.2.1 General instructions

1. For full credit you need to hand in a paper version of the assignments in class on the day they are due (see the schedule on page 9. Handing them in after the due date/time is considered late (e.g., coming late to class with it is late). See item #13 below.
2. So here are some ways to lose points before I grade these:
  - (a) -25% for each 24 hr period handed in late. Note that emailing it to me at noon on the day is due is the wrong way to hand it in (see next item) and is late by falling within the first 24 hour late period. If I find it under my door after I return from class it is considered late.
  - (b) -25% for emailing assignment on time and making me print it for you (unless pre-approved).
  - (c) -10% for no staple.
  - (d) -10% for including a title page
  - (e) -10% for not printing double-sided.
  - (f) -100%? Do not put it in my office mailbox. I rarely check that so many days may go by before I find it, rendering it very late.
3. Each assignment will have its own set of provided instructions. Additionally, each assignment is introduced in class. Missing these instructions could be costly. Read the directions carefully, complete the assignment, then re-read the instructions before handing it in.
4. Your write up can be short if you complete all required tasks (no rewards for being long-winded).
5. Use only complete sentences - poor writing and/or typos can cost you.
6. Include your name, date, and assignment name at the top of the front page.
7. Use single-spacing, double-sided printing for your write up.
8. Your report should be structured in numerical order to match the numbered question. Answer each question with any graphs and code before starting the next question.
9. The points for each question are found in the description. This represents the rubric that will be used to evaluate your work. For instance, a question might read: "(5 pts) Provide a publication-quality graph of these data." You earn all 5 points if you do this and lose points for things like not labeling your y-axis correctly.
10. If required include code you have written or modified (omit code I provided). It must be your own code so that, if asked, you could tell me what it all does. Do not try to find code online that you think solves your problem but you have no idea what it does. Feel free to refer to code that you have provided in a previous answer to avoid including the exact same code twice. Do not include screen shots of your code!
11. When using external literature provide complete citations. Citations for "scientific papers"

(which are primary literature papers) look like this:

Lastname-of-author, initials, (other authors listed). Year. Title. Journal. Volume(issue): pages.

12. All work must be your own. You also may not use a large language model, such as OpenAI's chatGPT, to edit or generate text because it is not guaranteed to be free from using the intellectual products of others. Feel free to review College's [policy on academic dishonesty](#).
13. **Finally, know yourself and accept yourself!** You probably know if using **R** challenges you, papers are hard to write, you tend to hand assignments in late, or you often have other challenges. So, be your own best ally. If you're healthy during this new era of a pandemic, get to work! You might not be able to pull off that all-nighter to complete an assignment. Be sure to use your resources (see above). So, I'm not really saying "plan ahead." It's more like "assume the plan will change so plan for the unplanned."

### 5.3 Getting help on the Ecological Application Assignments

For these assignments I believe in you! I know you can complete these successfully if we work together. My job is to give you all the information you need to succeed and to provide office hours to answer questions you have. There also are two awesome TAs ready to help you. Here are suggestions on how to proceed get help.

1. Read the directions. I've spent a lot of time writing the directions to these assignments. Did you start at the beginning? Frequently I've had students go straight to the questions and get stuck. Suffering with **R**? Did you work through the Appendices in your textbook? They're there to help you if **R** boggles you. Finally, don't stare at an error message for hours (I've heard this often!). If you can't get it after 5-10 minutes of using your **R** resources then move on to the next tips.
2. Come to my or your TA's office hours ready to explain your challenge. Have the **R** script file open on your computer with the cursor on where you're stuck. It'll probably be a quick visit.
3. Carefully draft an email of your question. Send your **R** script file as an attachment (not copied into the email and NEVER send a screen shot!) to me **OR** one of the TAs (don't email everyone!). Indicate the line number in the script file that's giving you trouble. If the code reads in a data file send that, too. We will run your code and see the exact same error message and will likely be able to tell you how to fix the problem.

Note that Dr. H. is unlikely to answer questions during darkness or on the morning the assignment's due.

### 5.4 Using your computer

To understand and complete work in the field of ecology you must be able to complete basic operations on *your* computer. This includes the following skills:

1. create a folder for this class, such as "PoE Spring 2023";
2. download a file from the internet and move it to your PoE folder;
3. install, run, and use MS **Excel** (and maybe **Word**), **R**, and **RStudio**;
4. search for help on the internet (e.g., search "make a folder on a Mac");
5. use your textbook's appendices (there are three dedicated to **R**).



## 6 Assessments (a.k.a., exams)

The content covered by the three assessments is cumulative. Any material covered up to the assessment can be included on the assessment (which might not align exactly with the schedule below). Note that the assessments increase in their weight. This is because, as with all classes, figuring out how someone is assessing your knowledge can be challenging. Be sure to read about the availability of old assessments in section 5 below. Here are some thoughts on these for this class.

1. **How I write assessments.** When I write these I do it mostly from scratch (I don't intentionally reuse questions). Some questions often will be similar because of this. I write the assessments using the readings, post-lecture notes (on Canvas in Files), and the homework assignments. Stuff I discuss (e.g., "what's new?" stuff) is also material you can be rewarded for knowing. I also write questions based on meetings where no notes were provided (e.g., the trip to the Arboretum and when only the board is used).
2. **What to bring.**
  - (a) Probably bring a pencil so you can erase. Crossing out gets messy. You have just enough room to answer questions once.
  - (b) Bring your calculator with fresh batteries. You may borrow these from people before assessments but **NOT** during assessments.
3. **No bathroom breaks?** During all assessments there are no rest breaks (you won't have time). Prepare yourself to be comfortable. This has evolved out of prior experiences where folks have created unfair advantages for themselves.
4. **Missing an assessment (exam).** Missing an assessment is a big deal. I am happy to work with you if you keep me informed with an **email notification** before the assessment and I receive from you evidence of your reason for missing class (e.g., notification from the health center).

But what if you can't make it because you're barfing that morning? Go to the health center instead. Email me evidence that you saw them. It is your responsibility to chat with me about this. Appropriate excuses include illness with evidence of your visit to an appropriate professional or notification through the Dean of Students Office (Phone: 585-245-5706; Email: deanstu@geneseo.edu).

5. **Past assessments** are provided in my OutBox in the PoE folder (see [CIT's wiki](#) to learn how to find Outboxes). I've tried to include both the test and the key. If it's not there it doesn't exist. Please note that old assessments may not reflect what your assessment will look like.
6. **Emailing questions.** Feel free to send me an email. Only send this from your Geneseo account (else it might be lost in my spam folder and you'll think I don't respond to emails). You can send me a screen captured image of a lecture slide or past test question and ask something **specific** about it. Never send a screen shot of **R** code (send the code)! The clearer the question the more helpful I can be. A question like "can you explain what the slide says?" is too vague and can't be answered by email. Please bring these types of questions to office hours. I won't be able to respond to questions the evening before or morning of an assessment (or the day a homework assignment is due). Please plan ahead!



## 6.1 Slay assessments

Be **your** strongest, most consistent and honest ally. So, **study like you're taking an exam**. Each study session should be no longer than the length of the exam for which you are studying. You probably know you wouldn't do your best on an exam constantly checking your phone, texting friends, and listening to music. Treat your study time with the same intensity/respect as when you are taking the test. Studying, therefore, should be tiring. It's just as important to take an awesome break between study sessions. Treat studying like a professional athlete who trains effectively and peaks at an event (the test). They do NOT prepare for an event by only training all night long before an event! Also, get that sleep you have heard so many times as being important. And eating well is really important. Eat like you're training for a race - don't fill up on comfort junk food (donuts?) before a big exam. All I'm really suggesting is that you use what biologists have taught us. I know professional athletes are listening to the biologists - you should, too!

### Additional thoughts

1. **Work through old exams.** Do not gloss over keys. Keys can help you check that you got the right answers.
2. **Carefully assess post-lecture notes.** Create questions based on the slides. What would Dr. H. ask on each slide? Don't just say "yeah, I get that" to a slide - this will not help you.
3. **Effective studying** is not measured by the amount of time spent studying.
4. **Use/form a study group.** Create questions for each other. Discuss how you would answer these questions. Don't let each other off the hook when an answer is not clear.
5. **Be bold and ask Dr. H. for help.**

## 7 Schedule

The following is the semester plan. Topics might not be exactly right but the due dates for homeworks and assessment dates are correct. For assessments you're responsible for all material covered before (they are cumulative).

1. EE = Ecological Explorations (see section 5.1).
2. EA = Ecological Applications (see section 5.2).
3. Readings are from the textbook The Science of Ecology (pdf on Canvas).

Date	Day	Topic	Do/Due/Bring
1/24/2023	Tue	Introduction to Ecology + Evolution. Introduction to EE #1	Read Preface + Chapt 1
1/26/2023	Thu	Adaptations in the Field. Meet at gazebo in the Roemer Arboretum. Check weather & wear appropriate clothes!	Review the Roemer Arboretum's mission on it's website.
1/31/2023	Tue	Evolutionary ecology and three models of evolution	Read Chapt. 2. Bring laptop with R and RStudio working. Have worked through textbook appendices A + B.

2/2/2023	Thu	EE #1 discussion. The Physical Environment (part 1).	EE #1 due. Read Chapt. 3
2/7/2023	Tue	The Physical Env (part 2). Introduction to EA #1	Bring laptop.
2/9/2023	Thu	Orgs in the Physical Env	Read Chapt. 4.
2/14/2023	Tue	Intro to Population Ecology	Read Chapt. 5.
2/16/2023	Thu	EA #1 Discussion. Unregulated growth	EA #1 due. Read Chapt. 6.
2/21/2023	Tue	Structured population growth. Introduction to EE #2	Read Chapt. 7.
2/23/2023	Thu	Regulated Growth	Read Chapt. 8.
2/28/2023	Tue	More Pop Growth + Behavioral Ecology	Read Chapt. 9 and bring laptop
3/2/2023	Thu	Assessment #1	Be prepared for Assessment #1
3/7/2023	Tue	Behavioral Ecology II + Game Theory. Introduction to EE#3	More with Chapt. 9
3/9/2023	Thu	EE #2 discussion. Metapopulations. Introduction to EA #2	EE #2 due. Read Chapt. 10. Bring laptop
3/14/2023	Tue	Spring Break	
3/16/2023	Thu	Spring Break	
3/21/2023	Tue	Behavior & Metapopulation 1	Read Chapt. 10
3/23/2023	Thu	Metapopulation + Competition	
3/28/2023	Tue	Competition Model on board	Read Chapt. 11.
3/30/2023	Thu	EA #2 discussion. Competition + Herbivory. Introduction to EE #3	EA #2 due. Read Chapt. 12.
4/4/2023	Tue	Herbivory + Predation	Read Chapt. 12 + 13.
4/6/2023	Thu	Assessment #2	Be prepared for Assessment #2
4/11/2023	Tue	Predation model on board	Read Chapt. 13.
4/13/2023	Thu	EE #3 discussion. Predation + Parasites, Parasitoids	EE #3 Due. Read Chapt. 13 + 14
4/18/2023	Tue	Pathogens + Mutualism, Commensalism, + Amensalism. Introduction to EA #3	Read Chapt. 14.
4/20/2023	Thu	Mutualism + stuff +Trophic interactions (food webs)	Read Chapt. 15 + 16.
4/25/2023	Tue	Trophic interactions	Read Chapt. 16
4/27/2023	Thu	EA #3 discussion. Spatial and temporal community dynamics	EA #3 due. Read Chapt. 17.
5/2/2023	Tue	Spatial and temporal community dynamics	Read Chapt. 18
5/4/2023	Thu	Biodiversity + Biogeography	Reac Chapt. 19 + 20
5/16/2023	Tue	Final. 12:00-2:30 for the 9:30 section. Schrader 1	Be prepare for Assessment #3

5/18/2023	Thu	Final. 12:00 - 2:30 for the 11:00 section. Schrader 1	Be prepare for Assessment #3

## 8 Office Hours

Join me on Mondays for Zoom office hours (<https://geneseo.zoom.us/j/4333683209>, passcode = 497118. For virtual meetings on Monday you might not get in right away because:

1. I'm with someone who wants a private conversation and so I'll let you in as soon as I can.
2. I'm dealing with someone from a different class and you wouldn't be interested.

If you can't wait send me an email with your question. In preparation for a zoom meeting you will be able to share your screen so you can get your questions ready before entering the zoom call.

## 9 Religious observances

It is my responsibility, as outlined in the College's Undergraduate Bulletin, to accommodate religious observances. No assessments have been scheduled to occur on notable observance days. However, as stated in the 2017-2018 Bulletin, I am "to comply in good faith with the provisions of..." section 224-a of the Education Law of New York State. I am happy to meet your needs if you inform me of any such absence at least one week prior to the conflict. Without you providing me this information I will not be able to help you meet your learning expectations for this class.

## 10 Accessibility challenges

I will do my best to make reasonable accommodations for students with documented physical, emotional, or cognitive disabilities. In addition, I will do my best to accommodate challenges brought about through pregnancy, parenting, or care giving. Students should contact the [Office of Accessibility Services](#) (585-245-5112) and me to discuss needed accommodations as early as possible in the semester. I am happy to accommodate your needs for completing assessments in the Test Center (<https://www.geneseo.edu/is/testcenter/main>) during class time, noting that you need to inform me of this at least one week in advance.

## References

- Hartvigsen, G. 2021*a*. Network assessment and modeling the management of an epidemic on a college campus with testing, contact tracing, and masking. *PLoS ONE*, **16(9)**. URL <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0257052>.
- Hartvigsen, G. 2021*b*. A primer in biological data analysis and visualization using R, 2e. Columbia University Press.
- Hartvigsen, G. 2023. The science of ecology. Provided PDF.

Far Side. Gary Larson

