

# BioSci 1540: Computational Biology

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# Chapter 1

## Welcome

This is the syllabus.

```
install.packages("bookdown")  
# or the development version  
# devtools::install_github("rstudio/bookdown")
```

## Chapter 2

# Introduction

**This is the syllabus for BIOSCI 1540: Computational Biology.**

This is both the first course in the core sequence of classes of the Computational Biology major and also an elective for most Biological Sciences majors.

This syllabus contains both key course policies and also is a repository for useful information about computational biology.

The first several pages contain key information about the course. Subsequent pages are organized alphabetically by major topic.

Pages marked “Appendix” are additional information about computational biology or research that you may find useful.

Your first assignment in the class will be to read through the syllabus and complete a “Syllabus treasure hunt” assignment on Canvas.

If you have a question about the syllabus (after you complete the syllabus treasure hunt) or even just spot a typo, post a comment on GitHub at [https://github.com/brouwern/BIOSCI\\_1540](https://github.com/brouwern/BIOSCI_1540)

You’ll be shown how to add comments on GitHub in class. The next page of the syllabus is a page for practicing adding comments.

## Chapter 4

# Meeting times

The course will meeting in-person on Tuesdays and Thursday.

**Location:** 1502 Posvar Hall **Days:** Tuesday & Thursday

**Times:** 4:00PM - 5:15PM Aug 31, 2021-Dec 10, 2021

There is no recitation for this course.

The official Pitt **Academic Calendar** can be found [here](<https://catalog.upp.pitt.edu/mime/media/212/3179/Academic+Calendar+2021-2022.pdf>):  
<https://catalog.upp.pitt.edu/mime/media/212/3179/Academic+Calendar+2021-2022.pdf>

## Chapter 5

# Instructor

**Nathan L. Brouwer**, PhD Office: Langley Hall 215A  
(In the former Neuroscience office suite)  
Email: nlb24 at pitt.edu  
Github: <https://github.com/brouwern>



## Chapter 6

# Academic integrity

Dr. Brouwer, the Bio Sci department, and the University all take academic integrity very seriously. Cheating includes any form of plagiarism, including copying other students' work or using other resources without proper attribution.

1. If you are caught cheating on a graded assignment, you will receive a zero on the assignment.
2. If you are caught cheating on an exam, you will receive a zero on the exam, an F in the course, and an Academic Integrity Violation Report will be filed.

Below is the University's Policy on Academic Integrity:

“Students in this course are expected to comply with the University of Pittsburgh School of Arts & Sciences Academic Integrity Code located at [www.as.pitt.edu/faculty/policy/integrity.html](http://www.as.pitt.edu/faculty/policy/integrity.html). Any student suspected of failing to meet the student obligations of the code during the semester will be required to participate in the procedures for adjudication, initiated at the instructor level. This may include, but is not limited to, confiscation of the assignment of any individual suspected of violating the code. A minimum sanction of a zero score for the assignment will be imposed. Violation of the Academic Integrity Code requires the instructor to submit an Academic Integrity Violation Report to the Dean.”

## Chapter 7

# Assessments Overview

The primary form of assessment in the course will be 5 unit tests.

The final is the 5th unit test, but will also draw on themes from throughout the semester

Other forms of assessment will include,

1. **Test revisions** (aka Test Reworks), which will count as a form of homework and do not add points back to your test.
1. **Canvas Quiz questions** related to lecture videos, **Code checkpoints** to assure that you can execute key functions, and **Software checkpoints** to assure that you have the proper software involved. 1. Additional homework 1. Practice tests or test preparation assignments.

### 7.1 Test-taking policies

Tests will be in-person during the regularly schedule time and administered as a combination of

1. Stand-alone canvas quiz questions
2. Canvas quiz questions based on code I provide
3. Code-based questions which you'll answer via a sepatate file, submitted via Canvas.

### 7.2 Key test policies

1. All answers will be submitted by the end of the normal class period.
2. If you are unable to take or complete an exam your score will be eligible to be dropped or replaced as specified elsewhere in the syllabus.

3. It is your responsibility to assure that you have adequate power in your devices and internet access to complete exams.
4. Adjustments will be made as necessary for students with DRS accommodations.
5. You may not communicate with other students while taking a test.

### 7.3 Test dropping policy

Your lowest unit test will be dropped. Your second-lowest score can be replaced by the final, if you score higher on the final. See the section on the final exam for further explanation.

### 7.4 Final Exam Policies

The final will cover conceptual material covered after the Unit 4 test. You will also need to draw on R skills from throughout the semester.

The final exam will ... 1, Take place during finals week on the day scheduled by the University 1. Is required 1. Follow the general format of other tests.

The final exam is required and will be scheduled as per the University calendar.

As noted elsewhere your lowest test score will be automatically dropped and your score for tests calculated based on your 3 best tests. Additionally, I will compare your performance on the final to those three tests and if your score on the final is higher then I will upgrade that score to your score on the final. Your final exam can therefore contribute to your score in 2 ways - as the final, and as a replacement of your second lowest of the 4 unit tests. Therefore, one of your exams is always dropped, and a second one is potentially replaced.

### 7.5 Exam “buffer question” policy

The unit tests and the final exam will have 1 to 2 “buffer points.” The way this works is that there will be, for example, 26 questions but the test will be worth a maximum of 25 points. The maximum score on the test will be capped at 25 points. If you miss 1 question you will get 25/25 points instead of 25/26. If you miss two questions you will get 24/25 and so forth. Scores greater than 100% will not be given.

## Chapter 8

# Assessments - Homework policies

Homework for outside of class will be assigned via Canvas.

**Late assignments:** Canvas will automatically deduct 0.5% of your score on all non-test assignments per hour, rounding to the nearest hour (12%/day). 29 minutes = 0 hours = full credit, 31 minutes = 1 hour.

## Chapter 9

# Course communication - Overview

### 9.1 Primary modes of communication

All important details will be sent via Canvas messages and mentioned/discussed in class. It is your responsibility to regularly check Canvas messages to stay abreast of the course. Most communication will occur on Fridays, but important updates may be sent out at other times.

### 9.2 Secondary modes of communication

#### 9.2.1 Github “issues”

In this class we will be making extensive use of the code management site GitHub. Most communication about homework and other assignments will occur via GitHub’s Issues] feature. In particular, to foster discussion we will use GitHub Issues to create forums around assignments and you will be required to submit comments.

#### 9.2.2 Microsoft SharePoint

Files containing code for this course will be distributed using Microsoft Sharepoint. Sharepoint has messaging features which I may pilot test but will not rely on.

## Chapter 10

# Course communication - Email and Canvas Messages

Announcements to the whole course via Canvas will occur typically on **Friday** afternoons. Other communication related to course administration will also occur via Canvas messages.

You can message me on Canvas or email me at nlb24 at pitt.edu.

Please include “Comp Bio” as the 1st thing in your email subject line with an informative bit of information as the “...”. e.g. “Comp Bio 2: problem accessing TopHat”. (Questions related to code are best submitted via GitHub).

If you use another email service as your primary email (eg GMail) please set your Pitt email to forward there.

For info on forwarding your Pitt email to your personal account follow this link: <https://bit.ly/2Riz7dx>

I try to answer all emails received on weekdays before 5 pm within 24-36 hrs. Emails received after 5 pm will be answered at the earliest the following morning. Emails received on the weekend will be answered Monday.

Please consult this syllabus before asking questions about course policies and the schedule, and refer to relevant information such as URLs, subject headings or dates. Screenshot are super helpful. If the entire answer to your question can be found in the syllabus I will likely respond by saying “*This is in the syllabus, Cheers, Dr. B.*”.

Questions relevant to the whole class may be reposted (with identifying details removed) to Canvas.

## Chapter 11

# Communication - University email policy

Each student is issued a University e-mail address (username at pitt.edu). This e-mail address may be used by the University for official communication. Students are expected to read e-mail sent to this account on a regular basis. Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications.

The University provides an e-mail forwarding service that allows students to read their e-mail via other service providers. Students that choose to forward their e-mail from their pitt.edu address to another address do so at their own risk. If e-mail is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University e-mail address.

To forward e-mail sent to your University account, go to <http://accounts.pitt.edu>, log into your account, click on Edit Forwarding Addresses, and follow the instructions on the page. Be sure to log out of your account when you have finished.

For the full E-mail Communication Policy, go to [bc.pitt.edu/policies/policy/09/09-10-01.html](http://bc.pitt.edu/policies/policy/09/09-10-01.html).

## Chapter 12

# Catalog description

The catalog description of this course is:

“This course is designed to give students a broad understanding of how computational approaches can be used to solve problems in biology. Both the biological and computational underpinnings of the methods will be addressed.”



## Chapter 13

# Course materials overview

Thanks to an Open Educational Resources (OER) grant from The Office of the Provost, there are no books to buy for this course - all course materials are free and will be provided digitally through Canvas.

Reading will take several forms:

1. files containing computer code (scripts)
2. articles and blog posts,
3. textbook readings.

Importantly, we'll be taking a very novel approach to the textbook for this course: **you will actually be building it yourself!**

Details will be provided in-class, but the gist regarding the textbook is:

1. Most weeks you will be provided 1 or 2 chapters of the book in the form of computer files ("scripts").
2. For homework you will do exercises embedded in the chapters.
3. When the exercises are successfully completed you will be able to convert the files to Web Pages and post them to your own Portfolio of book chapters and other completed activities.

# Chapter 14

## Course materials - Software

Installation and account creation for all software will be covered in detail during class or via assignments and accompanying videos. If you want to get prepared early for the course you can explore these on your own.

For information on getting started with R see *Get R Done!*.

### 14.1 Primary software

#### 14.1.1 Programming environment: R

We will use the open-source language R)(<https://cran.r-project.org/>) for almost everything in this course.

**NOTE:** If you have used R before that's awesome!

However, **Please update your installation when the class begins** - R goes through regular updates and works best with the newest version.

If you are having trouble installing R an excellent resource is: <https://learningstatisticswithr.com/book/introR.html>

#### **REFERENCE**

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. [www.R-project.org/](http://www.R-project.org/).

#### 14.1.2 Integrated developement environment (IDE)

We'll use RStudio as the front-end for working with R.

**NOTE:** If you've use RStudio before please update it when the course begins.

[RStudio](<https://www.rstudio.com/>: [www.rstudio.com/products/rstudio/download/#download](https://www.rstudio.com/products/rstudio/download/#download)

### 14.1.3 Cloud-based R

As a back-up to running R on your desktop I'll also introduce you to [RStudio Cloud](<https://rstudio.cloud/>). There are also several excellent primers which we'll use.

**RStudio cloud:** <https://rstudio.cloud/>

## 14.2 Code sharing

### 14.2.1 Microsoft SharePoint

R code and other files will be distributed to you via a personal folder on **SharePoint**, accessed via your **OneDrive** account.

You will need to “sync” your OneDrive account to your computer desktop to allow me to help you with your work. No code files will be shared via email or Canvas during the course.

**NOTE:** If you do not have access to a computer you can sync your OneDrive account please contact me so we can workout a system.

### 14.2.2 GitHub

Most code for this course will be available on GitHub and you will need to create an account for some activities.

Links will be distributed directly to you, but you can also see key resources pinned to my profile at <https://github.com/brouwern>

## 14.3 R packages

Many R packages (aka libraries) will be used in this course. Below are several key ones.

### 14.3.1 swirl

*swirl* is an R package that sets up interactive tutorials in your R console. It works both on desktop computers and RStudio cloud and is an excellent tool for learning and reviewing R.

Details for installing swirl can be found here in [Get R Done!](#).

### 14.3.2 Bioconductor

**Bioconductor** is a clearing house and repository for high-grade bioinformatics and computational biology software using R.

Details for installing Bioconductor can be found [here](#).

## Chapter 15

# Disability Resource & Services

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disabilities Resources and Services. DRS will verify your disability and determine reasonable accommodations.

216 William Pitt Union  
(412) 648-7890  
(412) 383-7355 (TTY)

## Chapter 16

# Extra credit policies

No extra credit will be offered in this course.

“Buffer questions” on the mini-tests and the final are NOT extra credit.

Exam revision assignments are not extra credit and do not add points to your test score.

## Chapter 17

# File names for homework

### 17.1 Files provided by me

You will be provided templates for most files you end up submitting for homework in this class. These file names will contain:

1. Your Pitt user name (e.g. nlb24)
2. Your last name or a concatenated version of it (e.g. brouwer)

If you receive an incorrect file name you may update it with your user name and last name. Otherwise, Please do not alter these file names unless instructed.

### 17.2 Files created by you

All files you create on your own which get submitted for homework need to be in lower case and **strictly** adhere to this format:

“pittemail\_lastname\_assignmenttitle”

Where I will provide the assignment title.

For example:

“nlb24\_brouwer\_assign\_1.rmd”

### 17.3 Incorrectly named files

Files will be downloaded and processed automatically so it is essential that your files are named correctly; errors may result in your assignment receiving a zero. There will be a grace period of 2 weeks where I will work with everyone to understand and use the file naming system.

**It is your responsibility to make sure you file names are correct.** If I spot an incorrectly named file I may have time to inform you so you can correct it, but this may not be until after the assignment is due and will result in points being lost as per the late assignment policy.

## Chapter 18

### Grading scale

Final.Percentage	Grade	GPA
98–100%	A+	4
92–97	A	4
90–91	A-	3.75
88–89	B+	3.25
82–87	B	3
80–81	B-	2.75
78–79	C+	2.25
72–77	C	2
70–71	C-	1.75
68–69	D+	1.25
62–67	D	1
60–61	D-	0.75
59 and below	F	0

**Note:** Students planning to major in Biological Sciences must pass this course with a C (not C- !) or better. Rounding is not done until final grades are computed and is done by computer to 1 decimal place.

Final letter grades are assigned after rounding and is done automatically by Canvas including the decimal value. For example, a score of 91.99% rounds to 92.0% and is an A, but a score of 91.94% rounds to 91.9% and is an A-.

Note: Students planning to major in Computational Biology must pass this course with a C (not C- !) or better.



## Chapter 19

# Masks and COVID-19

During this pandemic, it is extremely important that you abide by the public health regulations, the University of Pittsburgh's health standards and guidelines, and Pitt's Health Rules.

These rules have been developed to protect the health and safety of all of us. Universal face covering is required in all classrooms and in every building on campus, without exceptions, regardless of vaccination status. This means you must wear a face covering that properly covers your nose and mouth when you are in the classroom. If you do not comply, you will be asked to leave class. It is your responsibility to have the required face covering when entering a university building or classroom. For the most up-to-date information and guidance, please visit [coronavirus.pitt.edu](https://coronavirus.pitt.edu). and check your Pitt email for updates before each class.

## Chapter 20

# Metnal health & wellness

School is hard - please take care of yourself as best you can given the many demands on your time. Diminished mental health, including significant stress, mood changes, excessive anxiety, or problems with sleeping can interfere with your academic performance. You have a support network here at Pitt to help you through challenging times. Acknowledging that you need help, and getting that help, is smart and courageous.

- If you are in an EMERGENCY situation, call 911 or Pitt Police at 412-624-2121.
- If your symptoms are due to FINANCIAL strain, please visit [pitt.libguides.com/assistanceresources](http://pitt.libguides.com/assistanceresources) to see all available University resources.
- If your symptoms are due to strained RELATIONSHIPS, families, or personal crises, please visit the University Counseling Center at [www.studentaffairs.pitt.edu/cc/](http://www.studentaffairs.pitt.edu/cc/) for free confidential services.
- If your symptoms are strictly related to your COURSE WORK and performance in this course, please contact me.

### 20.1 Resources:

**University Counseling Center:** 412-648-7930

**Sexual Assault Response:** 412-648-7856

**RE:SOLVE crisis network:** 888-796-8226

**Pitt Police:** 412-624-2121

**Pitt Pantry food bank:** <https://www.studentaffairs.pitt.edu/pittserves/the-pitt-pantry/>

# Chapter 21

## Office hours

### 21.1 INSTRUCTOR OFFICE HOURS

**MONDAY:** Noon-1 pm. Zoom: <https://pitt.zoom.us/j/92563415506> Password: “BLOSUM” (all caps)

**WEDNESDAY:** Noon-1 pm Zoom: <https://pitt.zoom.us/j/92563415506> Password: “BLOSUM” (all caps)

**Other days:** By appointment: [calendly.com/brouwern](https://calendly.com/brouwern)

Office hours will be offered initially only via Zoom. After the first 2 weeks of the semester I evaluate if I will begin in-person office hours on Wednesdays.

### 21.2 UTA OFFICE HOURS

UTA office hours will be posted by the beginning of the 2nd week of lectures.

### 21.3 Individual appointments

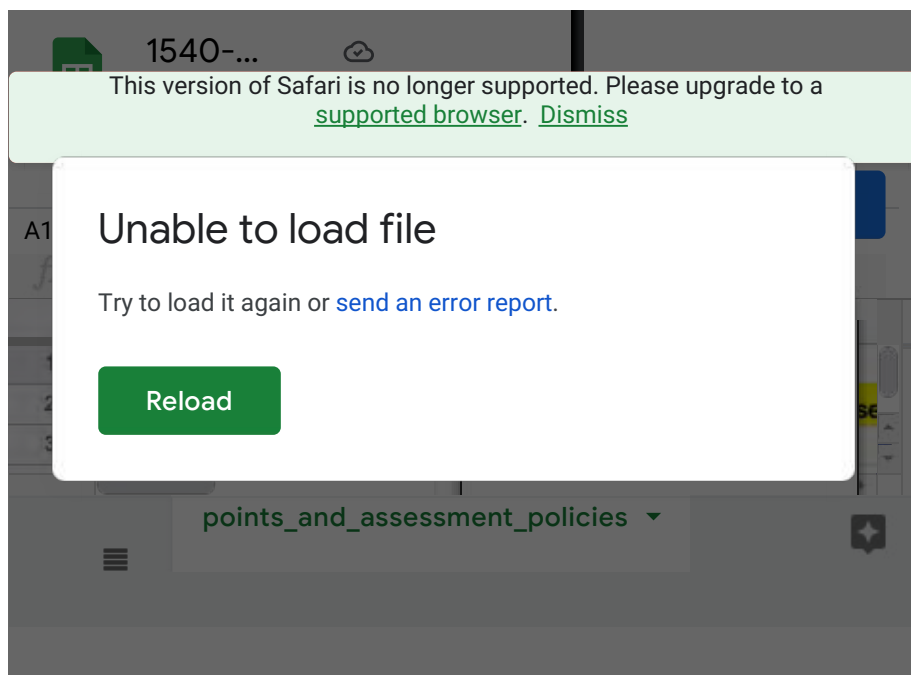
I’m available for individual 15 minute appointments 10 am to noon on Tuesdays, Thursdays and Fridays. Schedule these appointments via Calendly:<https://calendly.com/brouwern/15min>

If office hours or available times for appointments do not work for you, please email me to coordinate a different meeting time.

## Chapter 22

# Point breakdown

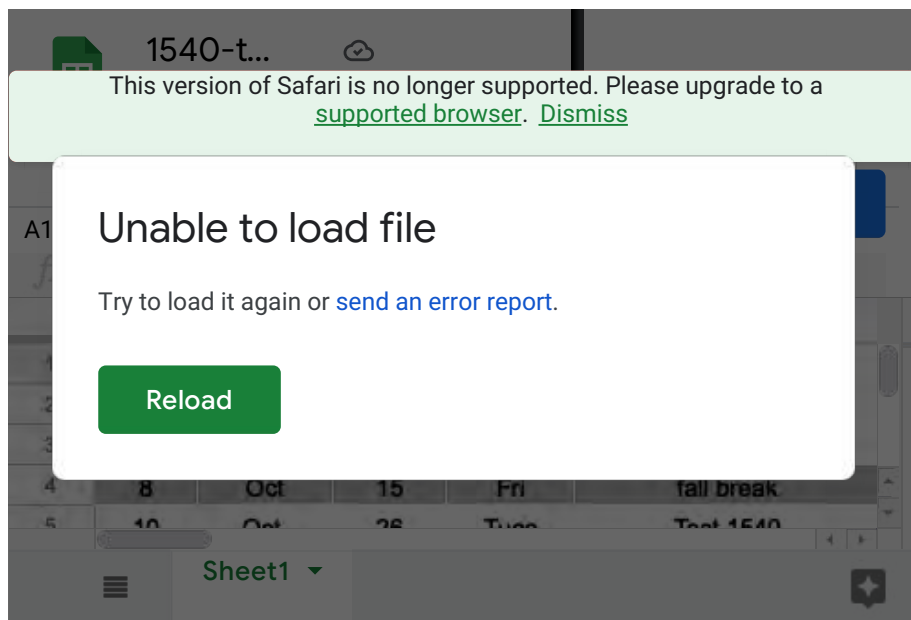
You can view the point breakdown and a summary of related policies here. Commenting is enabled; feel free to post questions.



## Chapter 23

# Semester schedule

The schedule of tests is available here.



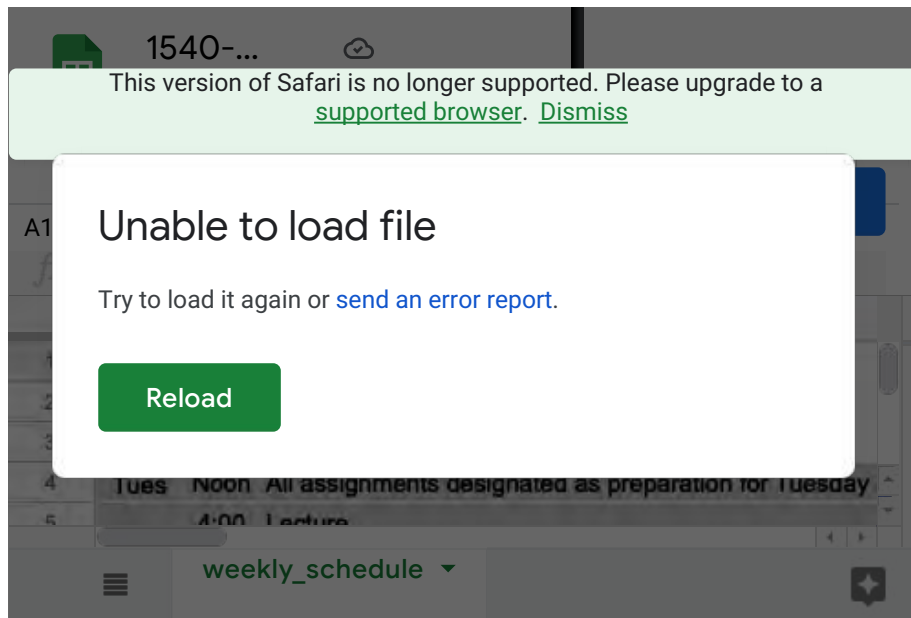
A calendar for the semester will be posted with key University dates and tests.

## Chapter 24

# Weekly schedule

A summary of weekly events is available [here](#). Commenting is enabled; feel free to post questions.

Each Friday I will send out an message via Canvas that will layout the topics and tasks for the following week.



## Chapter 25

# TopHat

We will use TopHat in-class and for homework. Please bring a charged TopHat compatible device to all lectures and recitations.

### **TopHat**

Join Code: **209015**

[www.tophat.com](http://www.tophat.com)

When logging into TopHat it will ask you for your university. Typing in “University of Pittsburgh” brings up 3 options: **select the first one** that just says “University of Pittsburgh”.

## Chapter 26

# Updates to schedule & syllabus

I reserve the right to update the syllabus, schedule, point allocation and all other components of the course as necessary.

If changes occur after the first day of class, they will be clearly communicated in class and via email, and a revised syllabus and schedule distributed with major changes flagged.



## Chapter 27

# Videos of lectures

The first two weeks of class lecture will be recorded using Zoom and posted to Panopto.

After the first lecture I will distribute the Panopto folder where the videos will be saved.

Note: Since this class is not meant to be taken asynchronously I will not actively support use of these videos.

## Chapter 28

### Zoom

Class will be in-person and streamed live via Zoom the first two weeks.

<https://pitt.zoom.us/j/99372114800>

Password: “BLOSUM”

## Chapter 29

# Appendix: graduate school

If you are considering graduate school you may wish to check out these resource:

So you want to go to graduate school? O'Connel, Tim. "A conversation about grad school" <https://eatmorecookies.wordpress.com/2018/07/17/a-conversation-about-grad-school/>

Carson, W.P. 1999. A primer on how to apply and get admitted to graduate school in ecology and evolutionary biology. *Bulletin of the Ecological Society of America* 80(4):246-250. (PDF here: <https://sites.google.com/site/walterpagecarson/publications>)

Stearns, S. Some modest advices for graduate students *Bulletin of the Ecological Society of America*, 1987 - JSTOR <https://stearnslab.yale.edu/some-modest-advice-graduate-students>

Thoughts on Stearns and Huey Fox, J. 2015. Re-reading Stearns and Hueys some modest advice to gradate students. <https://dynamicecology.wordpress.com/2015/09/08/rereading-stearns-and-hueys-some-modest-advice-to-graduate-students/>

On the publishing process: a tweet by dsquintana <https://twitter.com/dsquintana/status/1154820610750595072?s=20>

## Chapter 30

# Cheat sheets

RStudio produces a number of cheatsheets; the most useful ones for beginners are below.

**Basic R code**

<http://github.com/rstudio/cheatsheets/raw/master/base-r.pdf>

**RStudio** <https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf>

**RMarkdown** <https://github.com/rstudio/cheatsheets/raw/master/rmarkdown-n-2.0.pdf>  
<https://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>

Translations of some of these cheat sheets can be found at the bottom of the RStudio page.

## Chapter 31

# Appendix: Getting involved in (computational) research

Approaching a PI - A guide for undergraduates <https://thefemalescientist.com/guide/madeleine-hann/2053/approaching-a-pi-a-guide-for-undergraduates-in-stem/>

## Chapter 32

# Shortcuts in R

Programmers are often obsessed with using keyboard shortcuts. You'll see me use some, and you might want to learn them.

The back of this cheatsheet is a 1-page summary of shortcuts <https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf>

Another summary sheet of Shortcuts in RStudio is here: <https://support.rstudio.com/hc/en-us/articles/200711853-Keyboards-Shortcuts>

A great blog post on shortcuts is here <https://appsilon.com/r-studio-shortcuts-and-tips/>