

Exploring Biological Diversity

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Chapter 1

About

This is the online and FREE version of the introductory biology lab manual for Iowa State University (BIO211L). Within you will find all the information contained within the Canvas page.

1.1 Usage

Each **bookdown** chapter is an .Rmd file, and each .Rmd file can contain one (and only one) chapter. A chapter *must* start with a first-level heading: **# A good chapter**, and can contain one (and only one) first-level heading.

Use second-level and higher headings within chapters like: **## A short section** or **### An even shorter section**.

The **index.Rmd** file is required, and is also your first book chapter. It will be the homepage when you render the book.

1.2 Render book

You can render the HTML version of this example book without changing anything:

1. Find the **Build** pane in the RStudio IDE, and
2. Click on **Build Book**, then select your output format, or select “All formats” if you’d like to use multiple formats from the same book source files.

Or build the book from the R console:

```
bookdown::render_book()
```

To render this example to PDF as a `bookdown::pdf_book`, you'll need to install XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): <https://yihui.org/tinytex/>.

1.3 Preview book

As you work, you may start a local server to live preview this HTML book. This preview will update as you edit the book when you save individual .Rmd files. You can start the server in a work session by using the RStudio add-in “Preview book”, or from the R console:

```
bookdown::serve_book()
```

Chapter 2

Introduction

All chapters start with a first-level heading followed by your chapter title, like the line above. There should be only one first-level heading (#) per .Rmd file.

2.1 A section

All chapter sections start with a second-level (##) or higher heading followed by your section title, like the sections above and below here. You can have as many as you want within a chapter.

An unnumbered section

Chapters and sections are numbered by default. To un-number a heading, add a {.unnumbered} or the shorter {-} at the end of the heading, like in this section.

Chapter 3

Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

3.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: `# Hello world {#nice-label}`.
 - Leave the label off if you like the automated heading generated based on your heading title: for example, `# Hello world = # Hello world {#hello-world}`.
 - To label an un-numbered heading, use: `# Hello world {-#nice-label}` or `{# Hello world .unnumbered}`.
2. Next, reference the labeled heading anywhere in the text using `\@ref(nice-label)`; for example, please see Chapter 3.
 - If you prefer text as the link instead of a numbered reference use: any text you want can go here.

3.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using `\@ref(fig:chunk-label)` and `\@ref(tab:chunk-label)`, respectively.

See Figure 3.1.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

Don't miss Table 3.1.



Figure 3.1: Here is a nice figure!

```
knitr::kable(  
  head(pressure, 10), caption = 'Here is a nice table!',  
  booktabs = TRUE  
)
```

Table 3.1: Here is a nice table!

temperature	pressure
0	0.0002
20	0.0012
40	0.0060
60	0.0300
80	0.0900
100	0.2700
120	0.7500
140	1.8500
160	4.2000
180	8.8000

Chapter 4

Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Add a numbered part: `# (PART) Act one {-}` (followed by `# A chapter`)

Add an unnumbered part: `# (PART*) Act one {-}` (followed by `# A chapter`)

Add an appendix as a special kind of un-numbered part: `# (APPENDIX) Other stuff {-}` (followed by `# A chapter`). Chapters in an appendix are prepended with letters instead of numbers.

Chapter 5

Porifera, Cnidaria, and Lophotrochozoa

The first animal lab will focus on three groups of invertebrate animals: Phylum Porifera, Phylum Cnidaria, and the Lophotrochozoa. While Porifera and Cnidaria are both phyla (plural of phylum), Lophotrochozoa is a super-phylum. A super-phylum is a taxonomic ranking consisting of multiple phyla. In this case Lophotrochozoa consists of some phyla we will see in lab this week: Phylum Platyhelminthes, Phylum Annelida, and Phylum Mollusca, as well as some we won't discuss, such as Phylum Bryozoa and Phylum Brachiopoda.

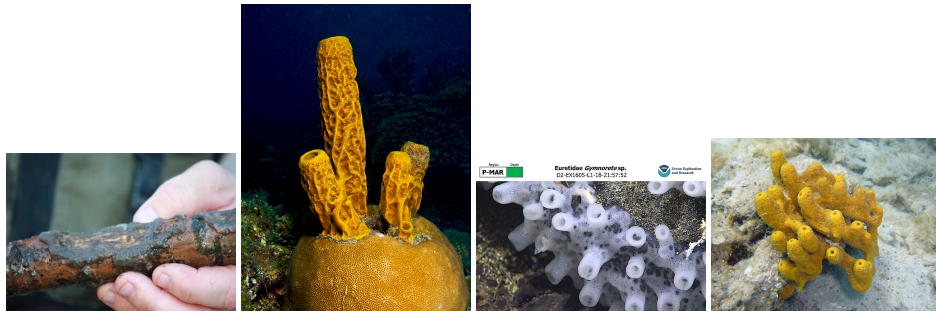
The following 10-minute video highlights how these groups are organized, including characteristics that reflect their evolutionary history and embryonic development.

5.1 Groups of interest

In this section we will briefly describe each group that we will be examining in lab this week, some of its common members, and its relative diversity.

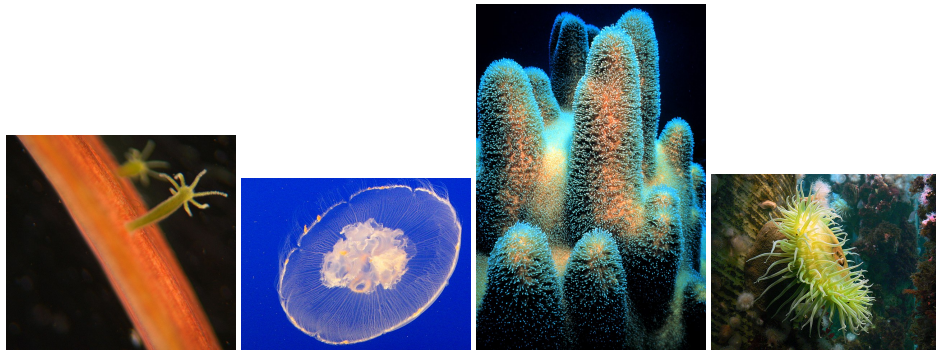
5.1.1 Phylum Porifera

This group contains approximately 8,500 species and is commonly known as the sponges. All Porifera are aquatic and most species live in salt water, but there are a number of freshwater sponges. For example, the first image on the left was collected in the Ioway Creek, east of the Iowa State University Campus.



5.1.2 Phylum Cnidaria

This group includes organisms called jellyfish, hydroids, sea anemones, and corals. This aquatic group contains approximately 11,500 species and many of these live in saltwater, but there also many examples of freshwater hydra and even freshwater jellyfish!



5.1.3 Phylum Platyhelminthes

This group within the Lophotrochozoa and includes organisms known as the flatworms, tapeworms, and cestodes. It contains about 20,000 species that live in marine and freshwater habitats, as well as moist terrestrial areas.



5.1.4 Phylum Annelida

This phylum contains around 16,800 species and is commonly known as the segmented worms. These worms live in every type of habitat: marine, freshwater, and terrestrial. In lab our focus will be on the segmented worms in the Class Clitella, including the dissection of an earthworm.

5.1.5 Phylum Mollusca

Molluscs are an incredibly diverse group of lophotrochozoans with over 85,000 species. The three classes within Phylum Mollusca that we will examine in class are Gastropoda, Bivalvia, and Cephalopoda.

5.1.5.1 Class Gastropod

This class has nearly 70,000 species, including snails, slugs, and nudibranchs. They live in marine, freshwater, and terrestrial habitats.

5.1.5.2 Class Bivalvia

This group is named for the two hinged parts of their shell and includes clams, mussels, scallops, and oysters. There are approximately 9,000 species that live in aquatic systems, both marine and freshwater.

5.1.5.3 Class Cephalopoda

This highly intelligent group of approximately 800 marine species includes squid, octopuses, and nautilus. Our exploration of this group will include a dissection of a squid.

5.2 Structures and Functions

This is the in-lab material. This section links to information on how the bodies of today's organisms are structured, how they eat, and details of their reproduction. These subsections will also highlight unique features that define the clade. You will be looking for these and other structures in the specimens placed throughout the classroom in today's lab.

5.2.1 Phylum Porifera

Chapter 6

Blocks

6.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad (6.1)$$

You may refer to using `\@ref{eq:binom}`, like see Equation (6.1).

6.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref{thm:tri}`, for example, check out this smart theorem 6.1.

Theorem 6.1. *For a right triangle, if c denotes the length of the hypotenuse and a and b denote the lengths of the **other** two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here <https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html>.

6.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: <https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html>

Chapter 7

Sharing your book

7.1 Publishing

HTML books can be published online, see: <https://bookdown.org/yihui/bookdown/publishing.html>

7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `gitbook` uses the same social sharing data across all chapters in your book—all links shared will look the same.

Specify your book's source repository on GitHub using the `edit` key under the configuration options in the `_output.yml` file, which allows users to suggest an edit by linking to a chapter's source file.

Read more about the features of this output format here:

<https://pkgs.rstudio.com/bookdown/reference/gitbook.html>

Or use:

```
?bookdown::gitbook
```