Structure of Scientific Writing

## Learning Objectives

1. Understand the basic sections of scientific papers.
2. Develop a plan for how to build your paper.

## How Science is Made

There are millions of scientific papers in published journals and thousands of university lab courses that require scientific papers in some form. The vast majority have these sections:

* *Title*
* *Abstract*
* *Introduction*
* *Methods*
* *Results*
* *Discussion*
* *References*
* *Tables*
* *Figures*

Later chapters of this book will discuss each of these in detail. In this chapter, we briefly introduce each section and then provide a guide for how to approach your writing project so that these rigid sections become a fluid and interesting scientific story. The lecture for this section is here: [Lecture Link](https://docs.google.com/presentation/d/1t8Ggc_xpu1eapc2UbTm8kGzCPWLQLi4AXnKyjM_4jKM/edit?usp=sharing)

## Title

* Short and descriptive

## Abstract

* One or two sentences that introduce the topic.
* One sentence that states your hypothesis.
* One sentence that briefly states what you did for methods.
* Two-three sentences of the *main* results with some quantitative information as needed (but no p-values).
* One or two sentences that summarize the main finding.

## Introduction

* What big question are you going to answer for us?
* Why is this question important?
* Lots of references
* 4-5 paragraphs is usually plenty.

## Methods

* What did you do to answer this important question?
* How did you analyze your data?
* Write what you did in a way that other people could repeat it.
* Doesn’t matter that your instructor knows what you did. It just matters that *other scientists* could understand it.
* Few references.
* 2-8 paragraphs is usually plenty.

## Results

* Write what you discovered.
* Clear and simple and quantitative.
* Don’t interpret anything. Just report the basic results.
* Usually zero references here.
* 1-4 paragraphs is usually plenty.

## Discussion

* Now you can interpret
* *The most important result of this study was…*
* Lots of references.
* 4-6 paragraphs is usually plenty.

## References

* What is known and unknown?
* Establishes trust between writer and reader.
* Gives credit to other ideas.
* Pick one format (there are lots of ways to write citations) and stick to it.

## Tables

* Summary statistics or raw data

## Figures

* Make the font readable
* Make them as simple as possible
* The reader should be able to guess what the figure axes will be based on the written sections above. No surprises.

# Putting it all together

You are probably familiar with some or all of these sections of a scientific paper. The next challenge is harder - finding a way to put these sections together so that they result in an understandable and perhaps even enjoyable thing to read. That is the hard part, and it’s why you’re taking this class or reading this book. Here are some tips to get you started.

1. *Hourglass Structure*

Think of your scientific paper as having a beginning that sets out the broad ideas, a middle that has all of the technical details, and an end that leaves you with a core take-home message. A common way to visualize that is with an hourglass in which each each section of the paper moves from top to bottom (Fig. X).

MAKE FIG X.

1. *Figures First*

One of our favorite ways to start writing a paper is to not write at all, but instead to work on the figures first. By figures, we mean the plots (or charts or data visualazations, etc) that show your scientific results. For example, if we had gathered data on the differences in survival of insects in response to pollution, we might plot them like this.

**Placeholder for plots from lecture slides labeling where intro, methods, etc can be gleaned from a good plot**