Notes on the Research article!

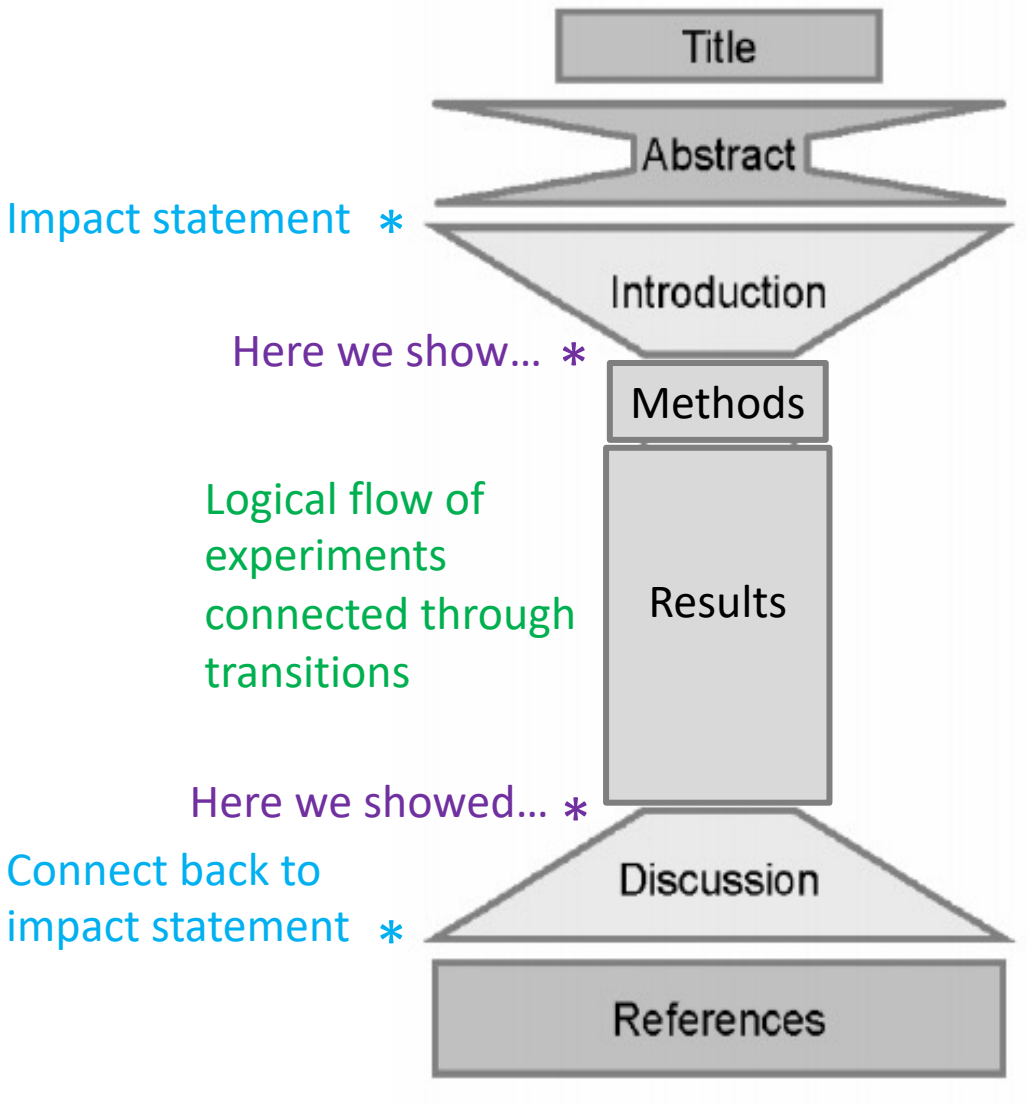
- Due date: Mon, May 1 @ 10pm

- Individual assignment
- No revision

- Text: Word doc or PDF
- Figures: in Word doc or PPTX

- Written in paragraphs (no more bullet points)

Overall suggested breakdown of RA components



- Title & Abstract (10%)
  - First page
- Introduction (10%)
  - ~2-3 pages
- Methods (20%)
  - ~2-4 pages
- Results w/ Figures & Captions (50%)
  - ~4-5 pages
- Discussion (10%)
  - ~2-3 pages
- References
  - Last page(s)

The Introduction

Components of the Introduction

From the wiki (but you already know that since you've read it!)

- **Opening paragraph: most general, "big picture" paragraph.** Here you should introduce the reader to the broader context of your experiment.
  - Why is your research important?
  - What is the motivation of your research?
- **Middle paragraphs: "zooming in" somewhat.** Once the reader has a frame for thinking about your research, you can present background information in more depth and motivation with more specificity. Here where you fill-in the details that are needed to understand the specifics of your research.
  - Is there a concept that is particularly important in your research?
  - Is there a pathway or protein that is particularly important in your research?
  - Is there a technique or experimental approach that is particularly important in your research?
- **Closing paragraph: most specific, a description of your particular investigation.** Now that the reader understands the context and current status of the field related to your research, you should highlight the knowledge gap. Once the knowledge gap is identified you should make your research question clear to the reader. Lastly, the introduction concludes with a brief preview of key findings and their implications (2-3 sentences total).
  - What is the knowledge gap that your research attempts to fill?
  - What is your research question?
  - What are the key findings from your research?

Can be different for each writer!

Make sure the research question can be addressed by your experiments

Structure of the Introduction

- Impact statement
  - Why is your research important?

- Specific background
  - Introduce topics important to understand the context of the project
    - Such as?
  - Narrow focus to the knowledge gap addressed in your study
  - Include citations!

- Knowledge gap
  - What remains unknown and how will your research question answer it?
  - Include your research question!

- Preview of your findings
  - Here we show…

The Methods

Notes on the Methods section

- Group methods in subsections with descriptive titles
  - Logical, not chronological
- Include an introductory sentence which explains purpose of method
- Methods are not protocols
  - Include the detail necessary for work to be repeated in a different lab
  - Do not need volumes or concentrations of stock solutions since these can vary
- Include genotype of any bacteria/yeast strains
- Include sequences of any primers used

Notes on the Methods section

- In addition to what you wrote for M2D6 (minus the IF experiment)

- Also include:
  - Uptake conditions and sample preparation for ICP-OES
  - ICP-OES (refer to email)
  - BacTiter Glo

The Results

How do you write about the results?

- Your goal was not to create a fully functional bioremediation system
- Module called “protein engineering”

- Everything you learned about how the mutations affected Fet4’s ability to take up cadmium and iron is valuable
  - Which amino acids appear to be important for Fet4 transport of cadmium and/or iron?

How do you write about results: in figures/captions?

Figure

- Organize figures logically
- Use figure subpanels as needed
- Limit text on the image, move extra details / explanation to the caption
- Use appropriately sized images

Caption

- Include title that is take-home message
- Include introductory sentence at start of caption if you have multiple panels
- Ensure caption has information needed to ”read” the figure
  - information about visualization, statistics, replicates, etc…
  - no interpretation

How do you write about results: in the text?

- State the goal / intent / purpose of experiment in the first sentence
- What you did: experiments, variables, controls used
- Describe the results you show quantitatively when appropriate
  - Not ”higher or lower”
- When you quantitatively describe your result, refer to the figure in the text (Figure 1a).
- What did you do next: transition to next experiment

What figures will be included in the Research Article?

1.

2.

3.

4.

5.

Where might you put?

- Overview schematic

- Rationale for mutation
  - What resources did you use to inform your design?

What are you supposed to do with class data?

- Many options (each paper can be different)

- Must compare your group's data to 2-3 other groups

<u>Can compare:</u>

- Different iterations of the same mutation
- Mutations by location in protein
- Other observations or connections that interest you in the data

Results vs Discussion Section

Reporting versus Interpreting your data

Results (i.e. what do you see?):

- What was the goal of the experiment?
- What controls/variables were tested?
- Data from the experiment reported quantitatively
- What experiment follows based on the results you report

Discussion (i.e. what does it mean?):

- What do you conclude from the data, and how do your results and controls support your conclusions?
- What is the context for your results?
  - Are there any unexpected results or technical issues that should be clarified?
- Overall, what does your data indicate and how would you follow up on it?

The Discussion

Components of the Discussion

- **Opening paragraph: most specific, a description of your particular investigation.** Here you should summarize your key findings and interpret the data such that the implications are clear. Then use the results to clearly answer your research question.
  - What did you discover in your research?
  - How do your results fill the knowledge gap identified in your introduction?
- **Middle paragraphs: "zooming out" somewhat.** Once the reader understands the results of your research, the data need to be contextualized. This means you should be honest about any limitations or unexpected results.
  - Were there any unexpected results? Is there a technical reason (i.e. an error in the setup or data collection)?
  - What follow-up experiment might you perform to clarify any unexpected results?
  - What are the limitations of your experimental approach? Is there another method that might better answer your research question? Is there another variable that should be tested to better answer your research question?
  - What next step experiment might you perform to further confirm your results?
- **Closing paragraph: most general, "big picture" paragraph.** Now that the reader understands your results, you should convey how your results move the field forward.
  - What is the broader implication of your research on the field?
  - How does your research advance what was already known?
  - How might your research improve a(n) health-related / environmental-related / technology-related issue?

Structure of the Discussion

- Here we showed…
  - Restate major results
  - Follow same order as in Figures/Results
- Describe your conclusions from your data
  - If necessary, describe caveats of experiment and suggest improvements
- Identify unknowns and speculate (within reason)
  - Don’t make huge generalizations or overreach
- Propose future experiments, identify new questions that arise
- Come back to the big picture / impact statement topic introduced in background

Ideas for Future works:

- What are some next steps?

- What are some broader experiments?

Remember: the Research Article will tell a story as a whole

- Introduction and Discussion should match
  - Preview / Review of the key findings
- Figures should be connected to Results
  - Figures should be referenced in Results text
  - Section headers in the results should relate to figures
- Results should be tied together with transitions
- Discussion should integrate the results together into a cohesive take-home message
- Final statement in Discussion should relate to impact statement from Introduction