

Research Manuscripts structure and writing process

20.109 Workshop

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Helping you communicate effectively.

be.mit.edu/communicationlab

So you want to write a paper...

What sections will you need to have?

What information goes into each section?

How do different audiences read a paper?

There are no explicit models for successful papers.

When you read a paper or sentence you like, collect it!



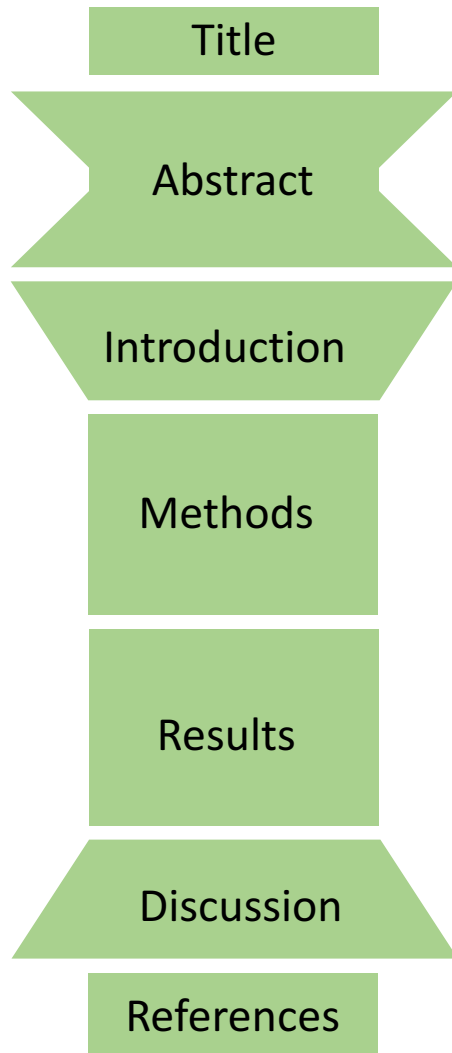
Analyze what makes it especially clear & compelling.
Try using their techniques.



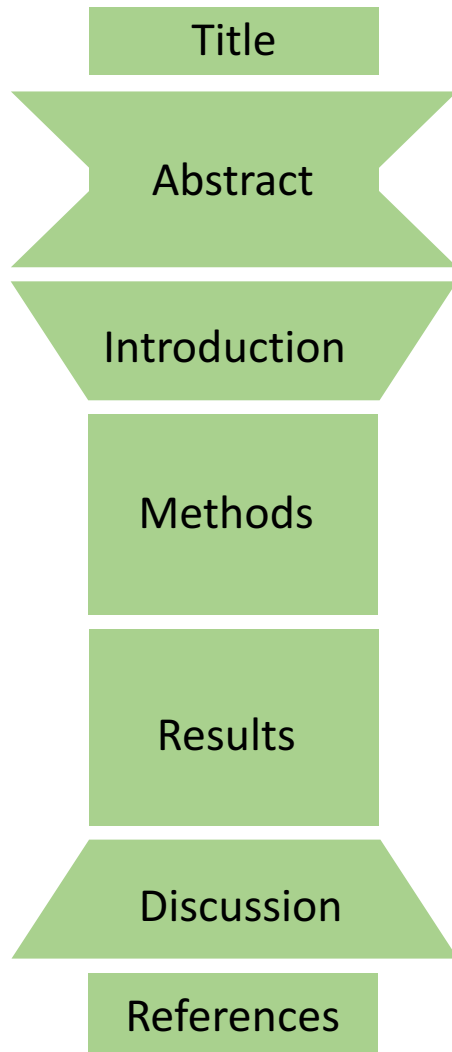
Revising is essential

- **Do not** try to write this paper in one day.
- Draft the sections, then set aside the paper for several days.
- If you get stuck: outline, write topic sentences, work on the next section, look at examples
- Get feedback:
peers, instructors, Comm Lab Fellows!
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Papers are often thought of as linear...



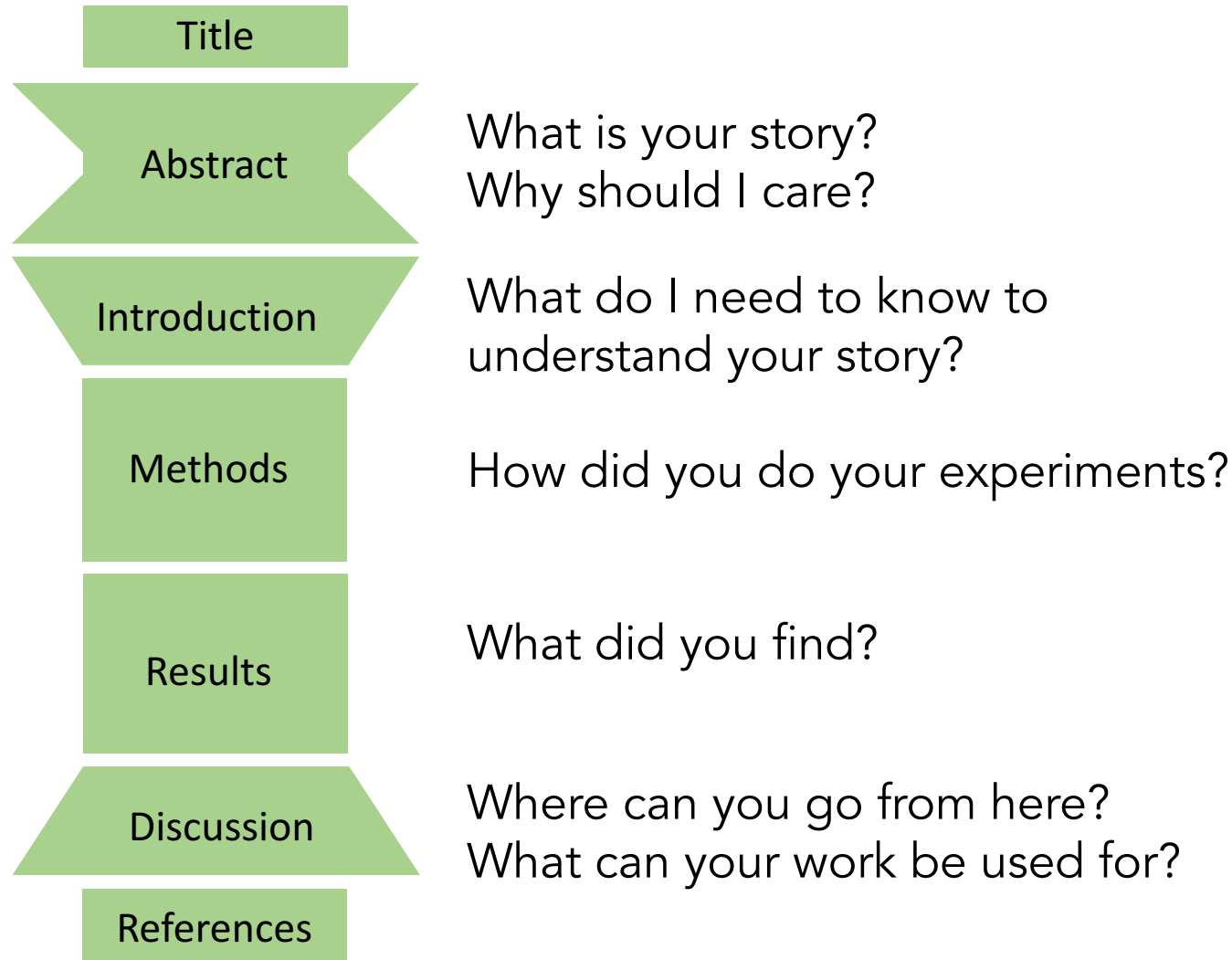
...yet are both
read and **written**
nonlinearly.



In what order do
you read a paper?

In what order will
you write a paper?

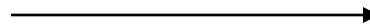
The sections of your paper answer different questions



Your paper tells a story about your data

Lab Notebook

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.



Lab Report or Paper

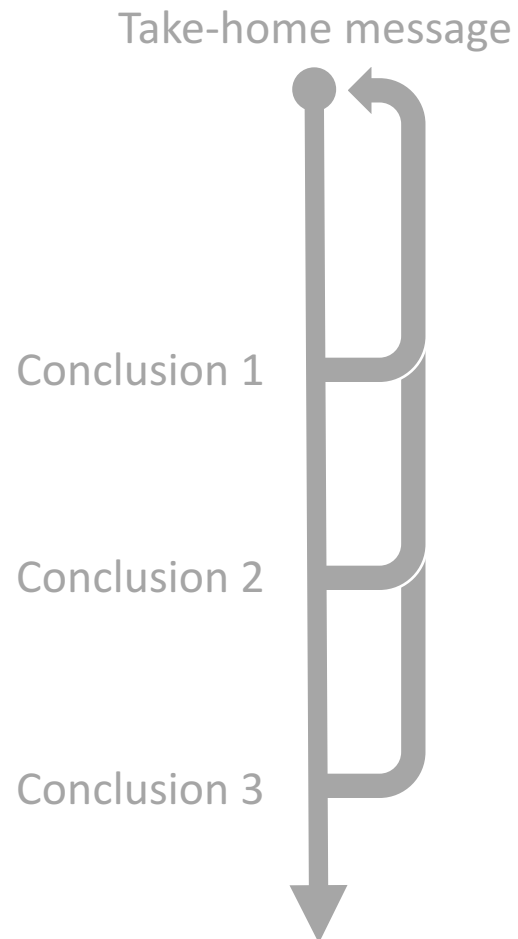
Background
Gap
Question

Answers from

- 4.
- 6.
- 1.
- 2.
- 5.

Create a single storyline.

1. Identify your **take-home message**; everything else leads to it.



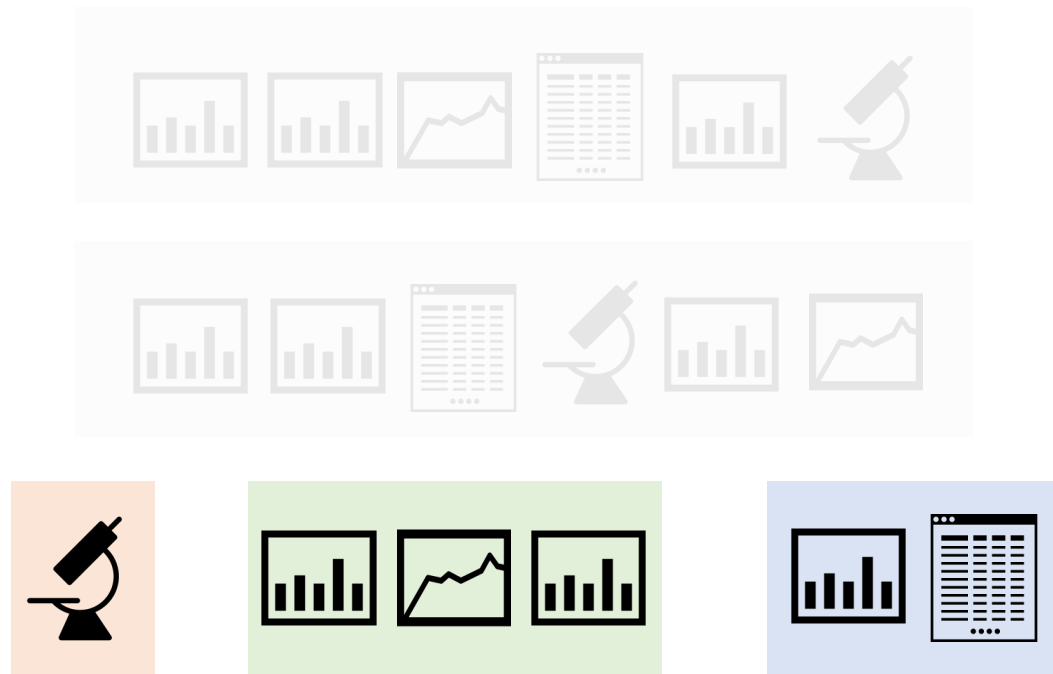
To find your story, organize your Figures.

2. Rearrange until you've created a **logical series** of conclusions.



To find your story, organize your Figures.

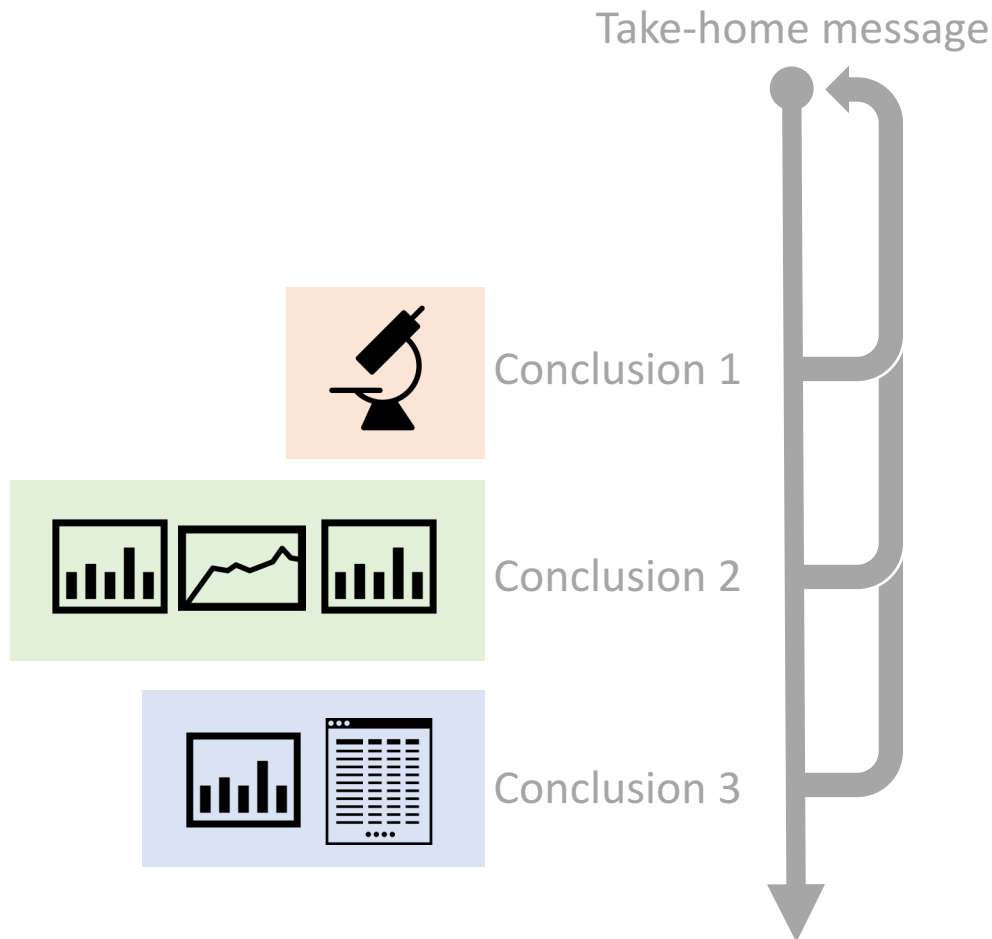
3. Identify **modules** that correspond to **conclusions**.



To find your story, organize your Figures.

3. Identify **modules** that correspond to **conclusions**.

Conclusion = title of a subsection.



Create a narrative by linking together modules that lead back to the take-home message.

We identified a druggable synthetic lethal interaction between DNA-PKCs and MSH3.

Activity Profile of KU60648 in a Large Panel of Genomically Annotated Cancer Cell Lines

Drug screen results
Functional clustering of mutations ...

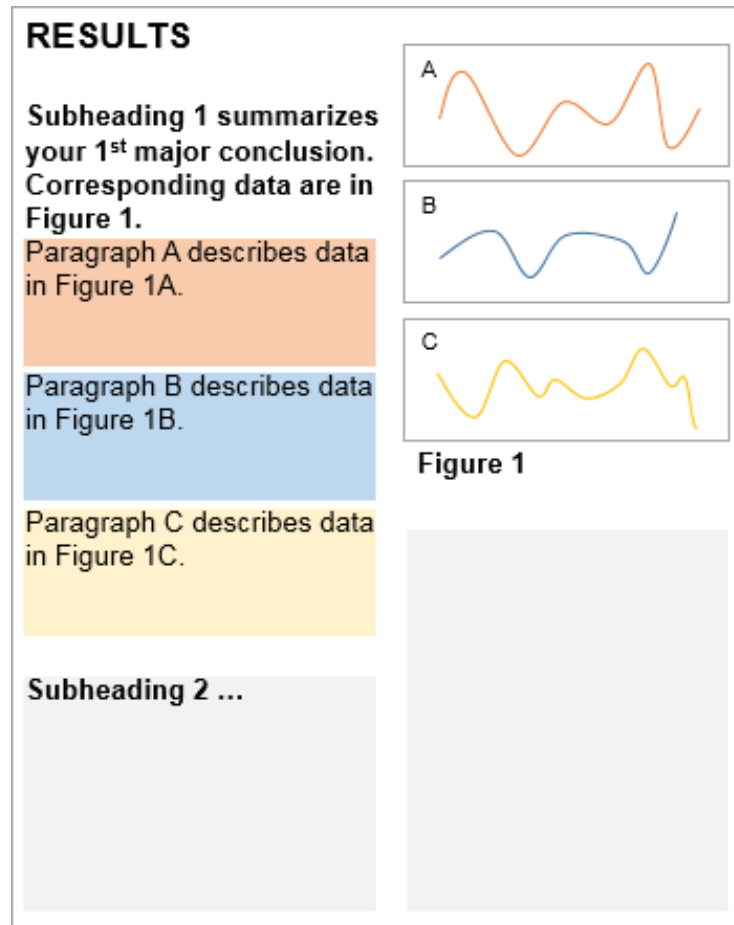
DNA-PKcs Inhibition Induces Apoptosis in MSH3 -Mutant Cells

Flow cytometry showing apoptosis
Morphology of DNA-PKcs knockout cells...

Genetic Validation of the Apparent Synthetic Lethality
Protein immunofluorescence of MSH3 mutants...

Use **parallelism**: Put all of your content in the same order.

Data || Results || Discussion || Methods



Paper structure:
Results + Discussion

Results = rationale + data + conclusions

RESULTS

Subheading 1 summarizes your 1st major conclusion. Corresponding data are in Figure 1.

Paragraph A describes data in Figure 1A.

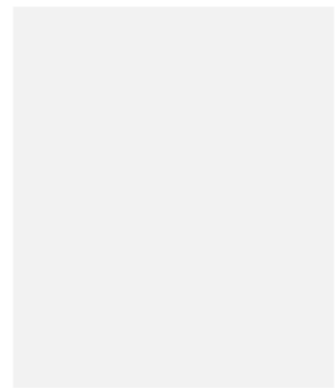
Paragraph B describes data in Figure 1B.

Paragraph C describes data in Figure 1C.

Subheading 2 ...



Figure 1



Results = rationale + data + conclusions

RESULTS

Subheading 1 summarizes your 1st major conclusion. Corresponding data are in Figure 1.

Paragraph A describes data in Figure 1A.

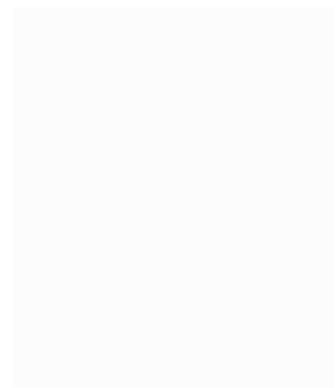
Paragraph B describes data in Figure 1B.

Paragraph C describes data in Figure 1C.

Subheading 2 ...



Figure 1



Results = rationale + data + conclusions

**In order to determine X,
Y was performed, showing Z
major results.**

Data + conclusions

pro, then con
most to least important
experiment vs. control

Transition sentence

re-summarize findings
justify movement to next
experiment or hypothesis

RESULTS

Subheading 1 summarizes
your 1st major conclusion.
Corresponding data are in
Figure 1.

Paragraph A describes data
in Figure 1A.

Paragraph B describes data
in Figure 1B.

Paragraph C describes data
in Figure 1C.

Subheading 2 ...



Figure 1

Results: Show minimal essential data.

Maximize signal-to-noise.

Include

- The experiment or dataset that is the **strongest proof** of your conclusion.
- Parts of your chosen dataset might contradict your main conclusion, or support one claim but not another.

Be clear and honest when describing any such contradictions, especially if they might reflect limitations like method shortcomings.

Results: Show minimal essential data.

Maximize signal-to-noise.

Exclude

(or put in Supplementary Information)

Experiments or datasets that...

- Also support your conclusion but are not the strongest proof

method is less validated

data are less statistically significant

data are less intuitive to interpret

- Were run to validate methods
- Were run to rule out alternative hypotheses

Results: Follow the Herskowitz Rule

amount of **time**
spent describing an
individual result

\propto

importance
of that result to the
paper's main conclusion



Ira Herskowitz, UCSF

Activity: Analyze the results section of a real paper

Take 10 minutes in groups of 2 or 3

1. Compare the results with the figures.
 - Are these parts organized well?
 - What do you think of the Figure titles vs. the Results subheadings?
2. Assess the paragraphs within the results.
 - Do they follow the rules of organization (in order to x, we did y)?
 - Do they draw conclusions? Are they speculative?

Speculation belongs in Discussion, not Results.

Summary of paper's main conclusion

Comparison with previous
results or theories

Scientific or engineering implications of
this work

Paper's limitations in scope

Forward-looking statement

Speculation belongs in **Discussion**, not Results.

Summary of paper's main conclusion

1 or 2 sentences

Comparison with previous
results or theories

Scientific or engineering implications of
this work

No more than 1 degree
of speculation

Paper's limitations in scope

Forward-looking statement

A successful **Discussion** can be useful to both experts and non-experts.

Summary of paper's main conclusion

Comparison with previous results or theories

Scientific or engineering implications of this work

Paper's limitations in scope

Forward-looking statement

Expert asks:

How do you account for results that contradict the rest of the field?

Expert asks:

How do you explain confusing or complicated results?

Activity: Analyze the Discussion

Take 8 minutes in groups of 2-3

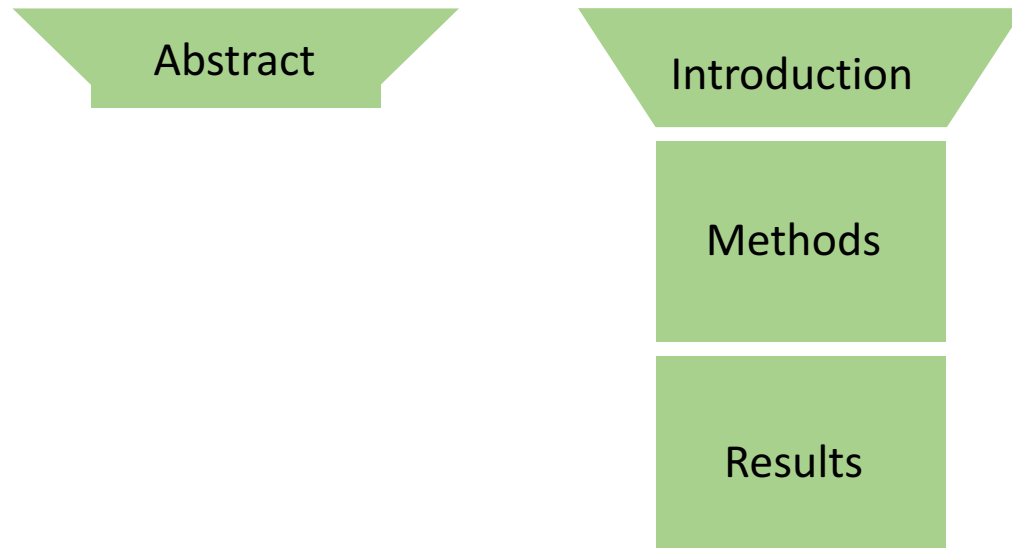
- What is the impact?
- Where might it lead?
- How's their speculation level?
- Are there any limitations mentioned?

Introduction = **Why** did you do this research?

- Your research taught you something, right?
- Introduction convinces the reader that this knowledge is worth having
- background + knowledge gap + here we show

Introduction = **Why** did you do this research?

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Introduction = Why did you do this research?

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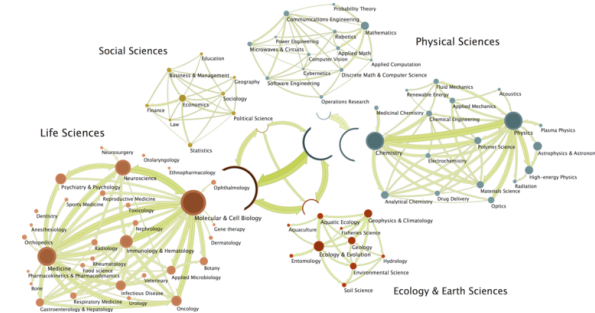
Activity: Let's read the Introduction to this paper
Individually, take 5 minutes

Paragraph structure helps you and reader

- One paragraph = one thought.
- 1st sentence summarizes this thought.
- Last sentence reiterates.
- Elaborate in a logical order, for example:
 - pro then con
 - most to least important evidence
 - chronological

References connect your paper to the research ecosystem

- Built over the course of the paper
- Make sure you include papers that...
 - reach conflicting conclusions
 - are from your competitors
 - were published during the course of your work(Reviewers will be looking)



Assignment or paper questions?

- Due 10pm, Mon. Nov. 20th
- 20% of course grade (full rubric on wiki)

Title and Abstract		10%
Introduction	2-3 p.	10%
Methods	3-4 p.	20%
Results and Figures	4-5 p.	50%
Discussion	2-3 p.	10%

(12pt., double-space except Abstract, max.14 pages)