SCIENTIFIC WRITING:
Jo-Anne's world view…

Outline

- **Why?**
- What?
- How?

Why Write?

- If you don't write it, you may as well not have done the work.
- If it's not written *well*, you may as well not have done the work.
- Sharing promotes scientific progress.
- **Papers are academic currency.**

When writing your (paper, thesis, etc.)...

...Remember the audience!

⇒ You want the reader to have to do as little work as possible to understand what you are writing!

⇒This is the underpinnings of everything I will talk about today!

Who is your audience?

Thesis: Internal-external examiner

Paper: Colleagues? Students?

Depends on the journal...

Identifying your audience will help focus your writing.

Outline

- Why?
- **What?**
- How?

Before you begin,
ask yourself these three questions...

The Magic Three

- **WHAT** is your topic?
- **WHY** is it important?

} **"The Big Picture"**

- **HOW** did you contribute?

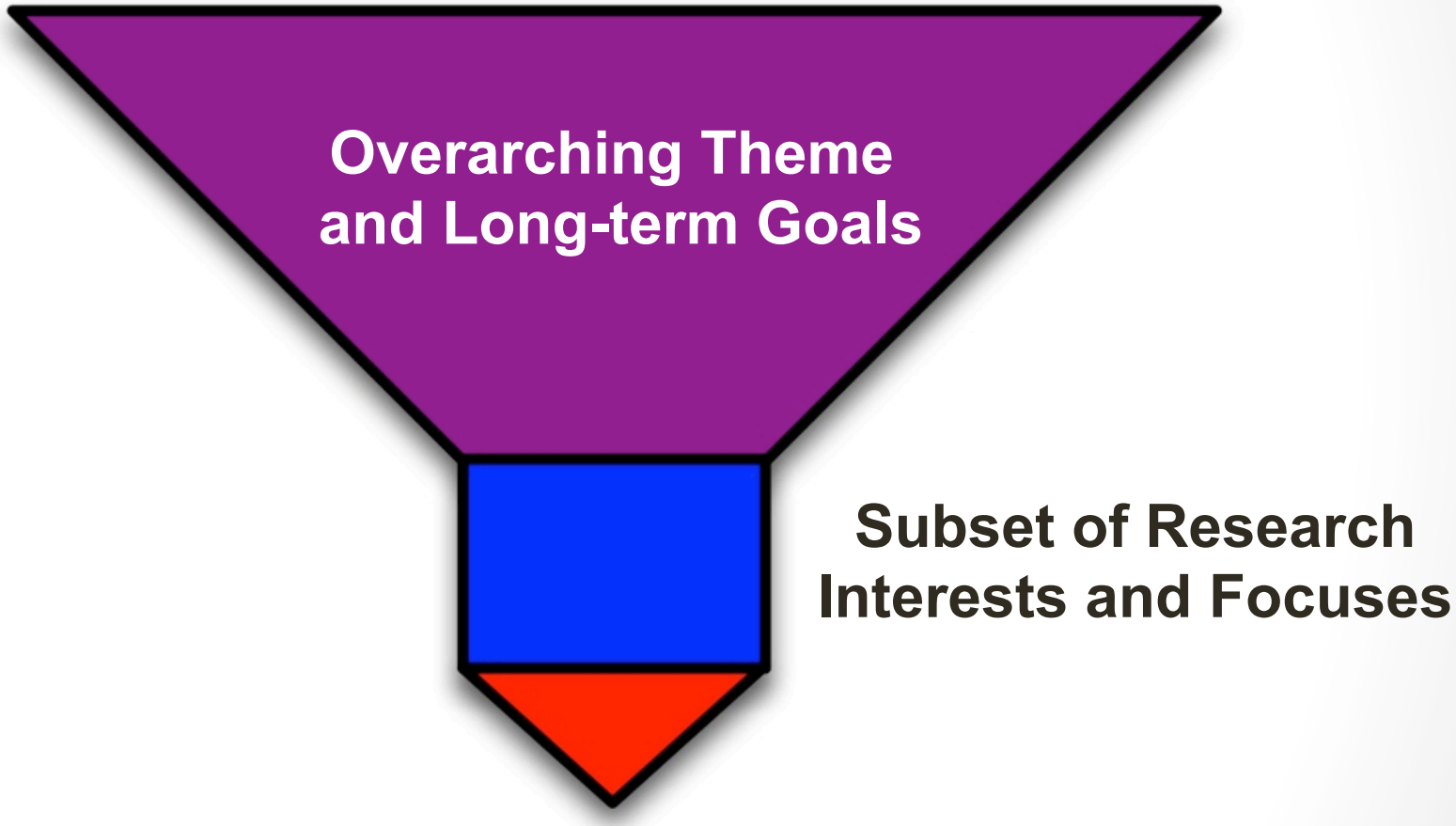
The magic 3 can be used to write abstracts, introductions, presentations….

Visualizing the “Big Picture”

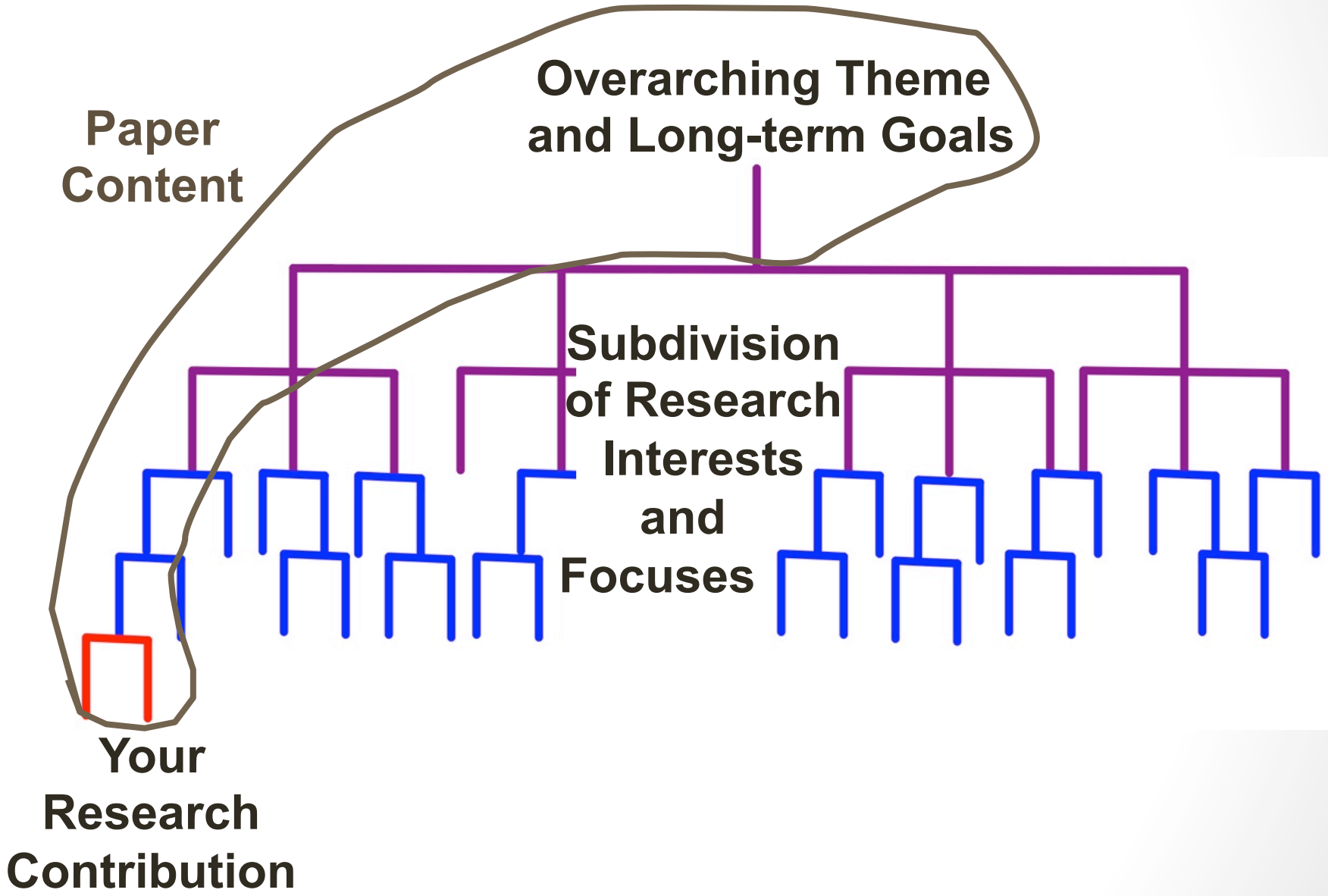
There are many ways to ‘visualize’ a science story – here are a few ideas...

Umbrella Model

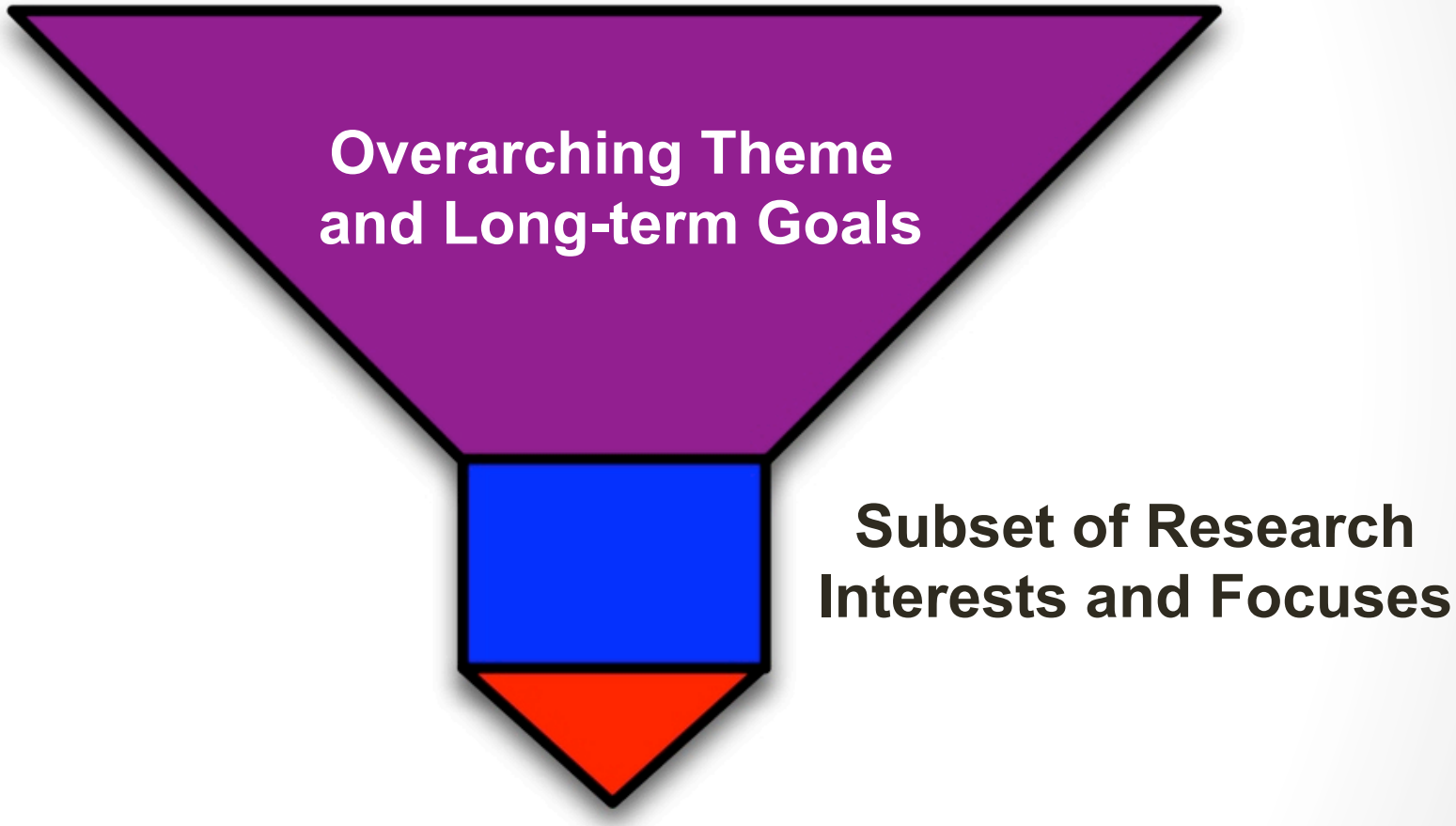
Funnel Model



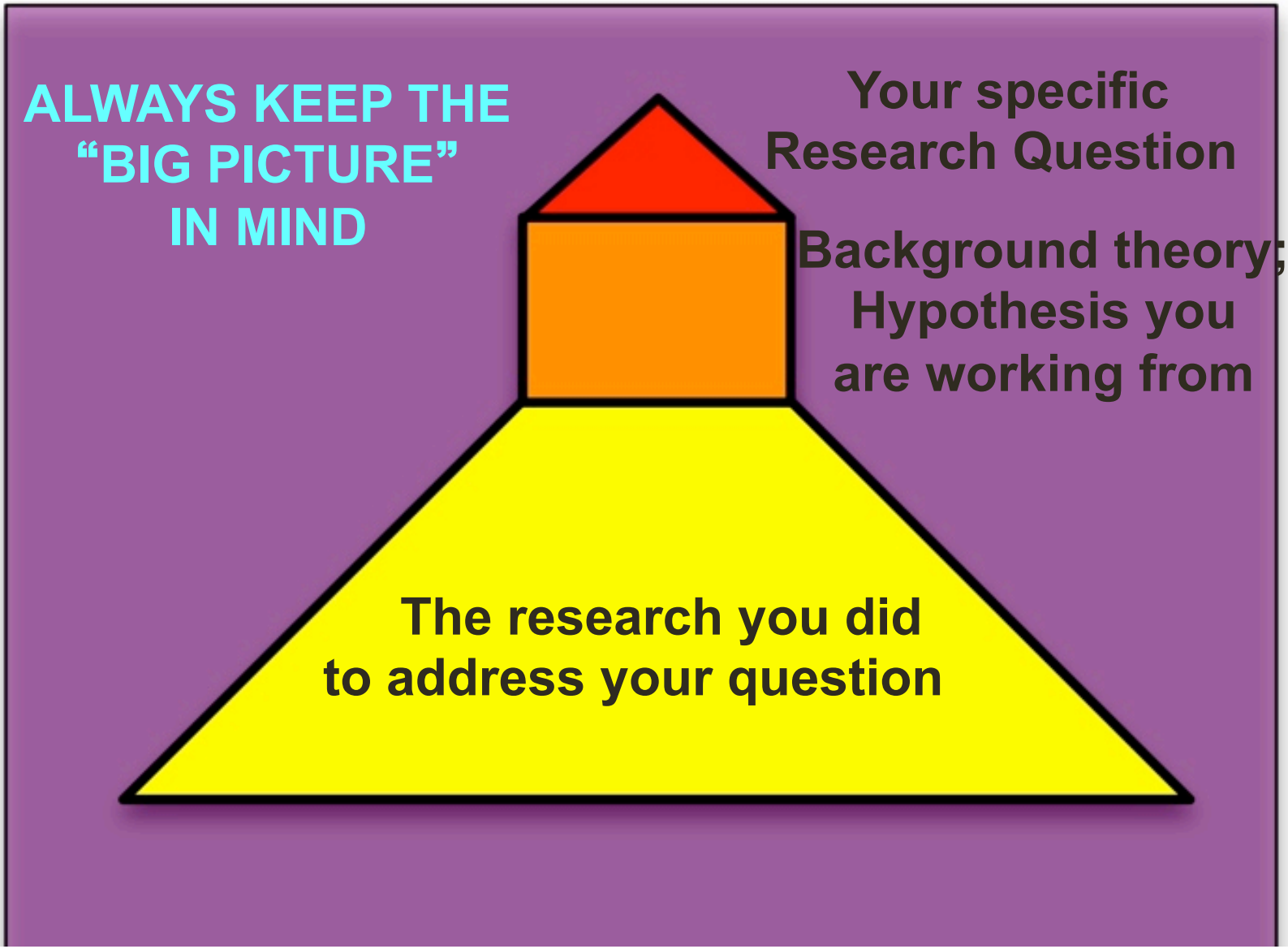
Tree Model


Overarching Theme
and Long-term Goals
Paper
Content
Subdivision
of Research
Interests
and
Focuses
Your
Research
Contribution

Funnel Model

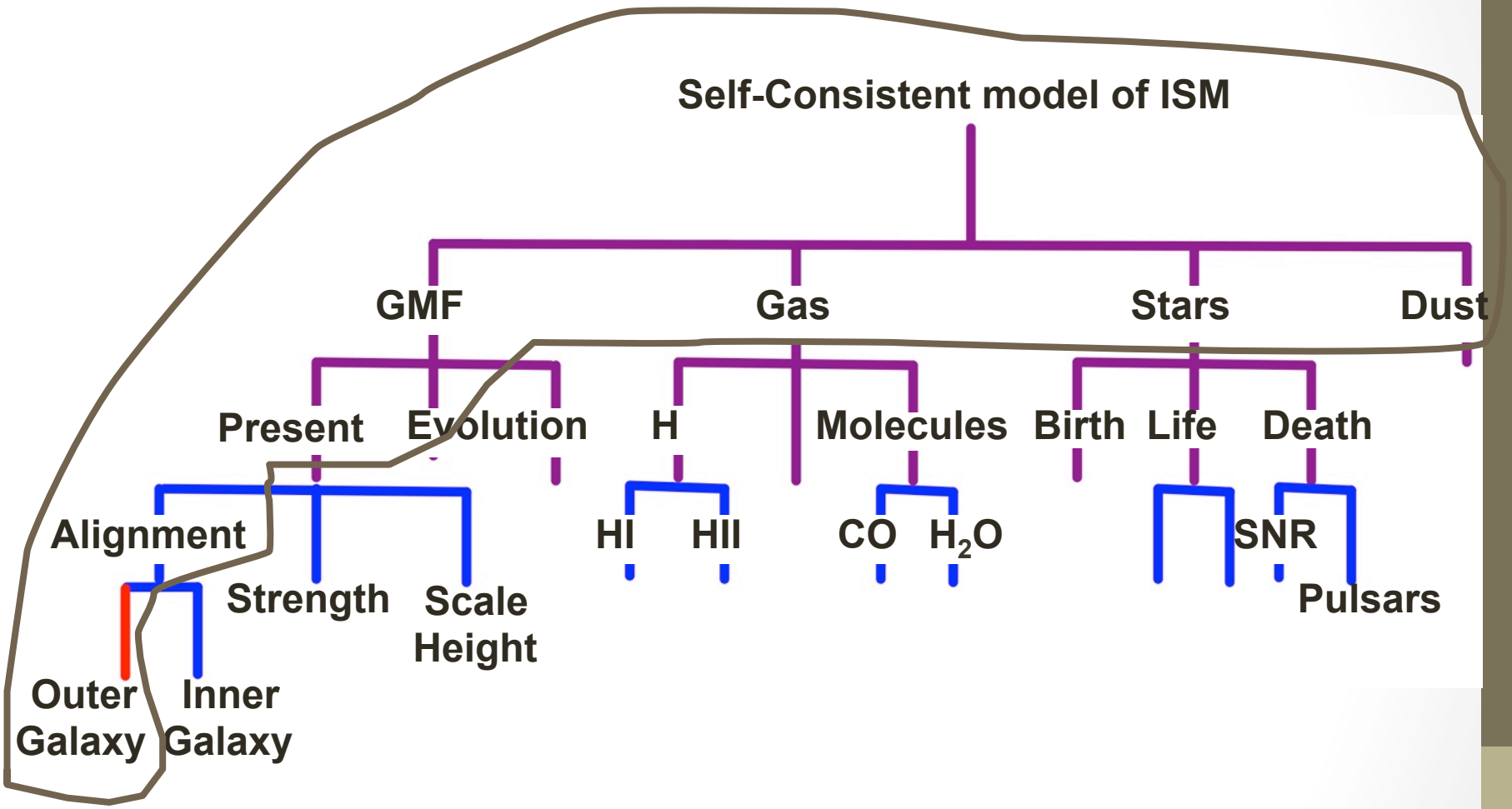


Funnel Model



Funnel Model

Tree Model - Example



The Magic Three

- **WHAT** is your topic?
- **WHY** is it important?
- **HOW** did you contribute?

What is the best way to communicate this?

The Three T's

- **Tell them** what you are going to tell them
  - *Abstract* **(1)**
- **Tell them**
  - *Body* **(3)**
- **Tell them** what you told them
  - *Summary* **(2)**

The Three T's

- **Tell them** what you are going to tell them

– Abstract (1)

Make sure your "walk away" points are in your abstract!

– Summary (2)

Think about the "Summary" FIRST

- What do you want the reader to walk away with?
- Keep your paper consistent with these goals!
- Don't add things or discuss things beyond these goals!

CXR 11

A Study of the Interstellar Magnetic Field in CXR 11

J.C. Brown, A.R. Taylor and M. Peracaula

Department of Physics and Astronomy, University of Calgary, Calgary, AB, T2N 1N4

Abstract. By studying the properties of polarised radiation in the Canadian Galactic Plane Survey images (Stokes Q and U in particular), we are developing techniques to deduce information about the interstellar

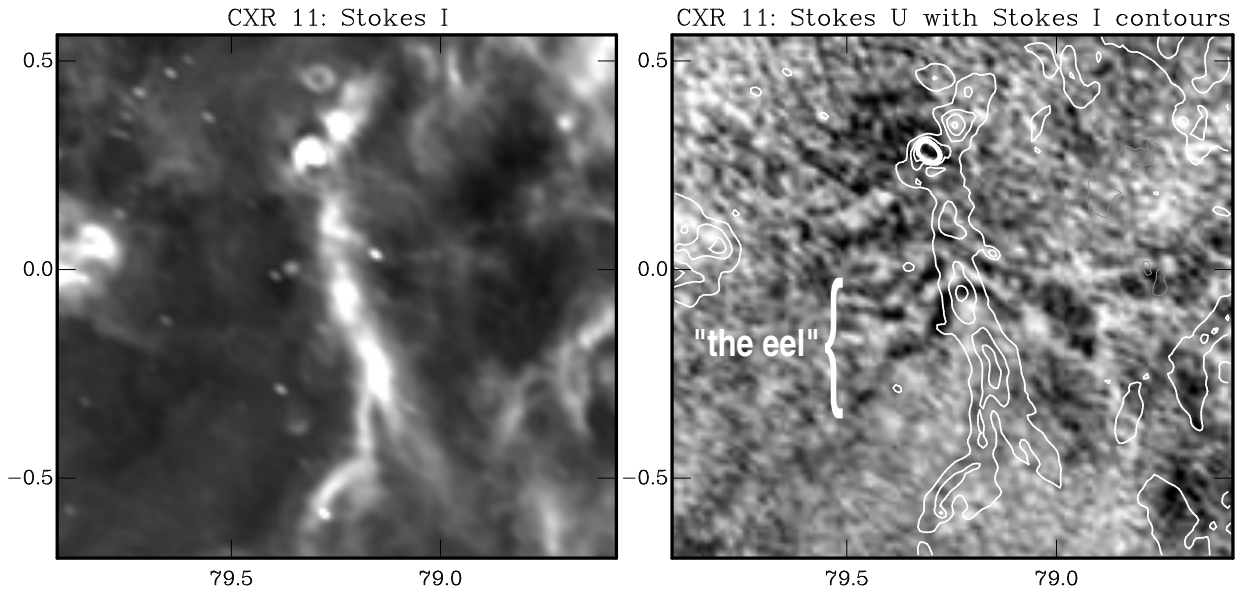


Figure 1. CXR 11 in a) Stokes I; b) Stokes U with Stokes I contours.

wide field polarimetry of diffuse polarised structures in the plane of the Milky Way. A special situation has been discovered in Cygnus X where a polarised

My Thesis Outline

1) Introduction to the Galactic Magnetic Field
2) Necessary Theory of Wave Polarisation
3) The Data: Radio Observations from Penticton
4) Rotation Measures from DRAO
5) CGPS Rotation Measure Sources
6) Data Analysis: What do the Rotation Measures Tell Us?
7) Modeling the Galactic Magnetic Field
8) Summary and Conclusions

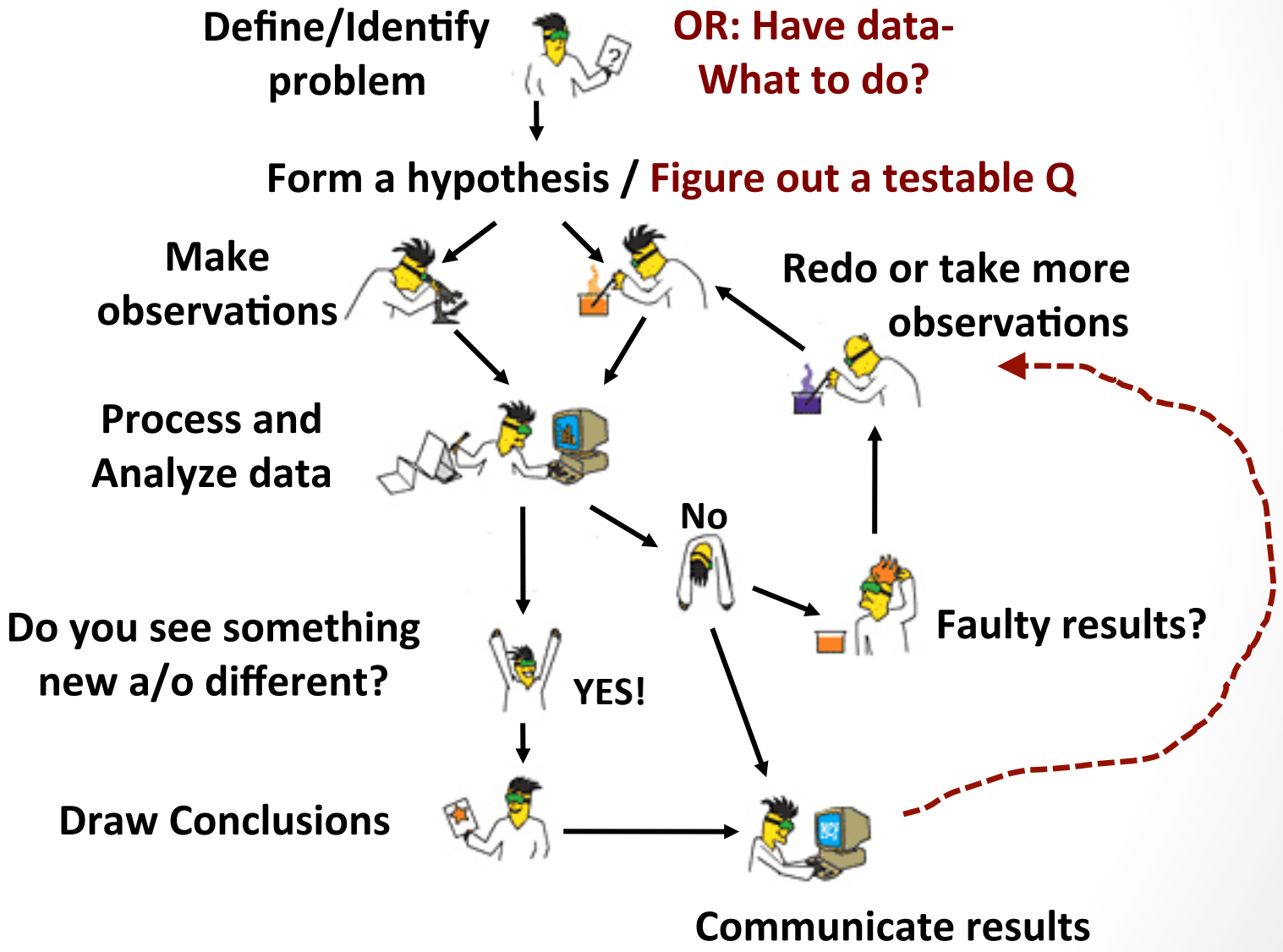
=> No CXR-11

The Scientific Method

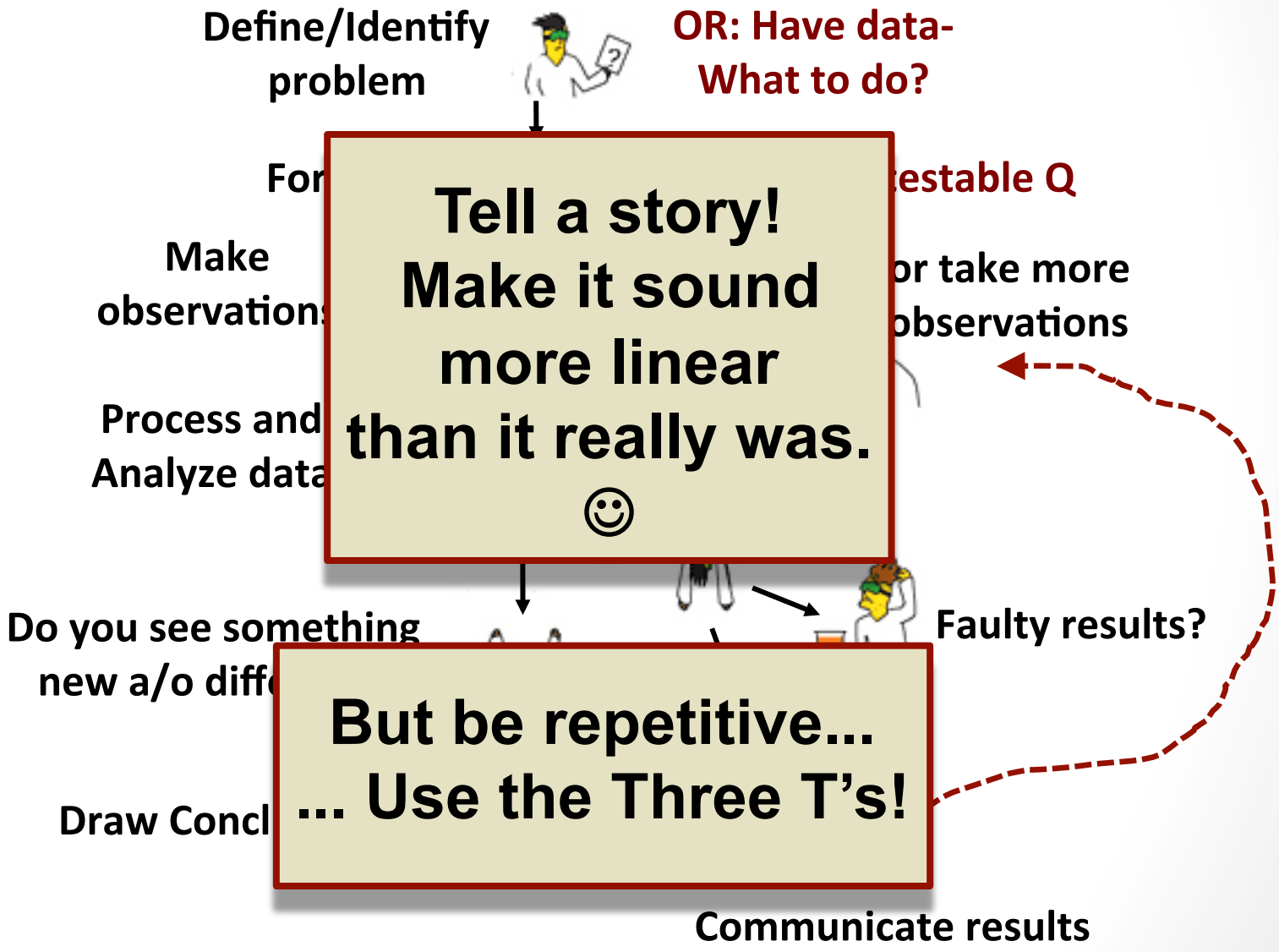
https://www.youtube.com/watch?v=KIFz_-KzURY

- Make an observation
- Ask a simple question
- Form a hypothesis
- Make a prediction
- Do a test/experiment (with a control and a variable!)
- Analyze the data
- Draw a conclusion

The 'Reality' of Science



The 'Reality' of Science



Outline

- Why?
- What?
- **How?**

SCIENCE 331
SCIEN

Jo-Anne's brain-dump on things she wishes she could tell every student and now has the chance!

A Guide to Writing Formally

- Sentence structure (including ROS)
- Paragraph structure
- Document structure
- Spelling (including homonyms)
- Punctuation
- Person / Voice / Tense
- Equations / Figures / Tables
- Citations!

Things people look at...

...even if they don't realize it.

Writing a Sentence

Sentence structure

A sentence…

- Contains a subject (noun) - *About who or what.*
- Contains a predicate (verb) - *The action the subject did.*
- Starts with a capital letter
- Ends with some form of punctuation:
  - period (for a statement) = .
  - Question mark (for a question) = ?
  - Exclamation mark (for a surprise or shock or emphasis) = !

"!" Is rarely used in scientific writing!

Sentence structure

A sentence…

- Should be 'readable' in one breath. Three-five lines is too long! (= Run-on Sentence or ROS).
- Should NOT begin with "Because". Rearrange or use "As a result…" or "As a consequence"
- Should be complete! Scientific writing should not contain 'sentence fragments' (incomplete sentences).

Every rule is made to be broken, but be careful!

Sentence structure

Incorrect: After classes, then the library. My life these days.

Correct: After classes, I will go to the library. This is what my life is like these days.

Writing a paragraph

=> Use the three “T”s

How to write a paragraph

- Tell the what you are going to tell them:

  => 1 topic per paragraph

  => write a topic sentence!

- Tell them:

  => The body supports the topic sentence.

- Tell them what you told them:

  => Conclude the paragraph

  => write a summary or transition sentence!

Also… think about the audience!

How to write a paragraph

- **Unity**

=> The topic sentence sets the stage!

- **Order**

=> chronological, order of importance etc.

- **Coherence**

=> The sentence should flow together.

- **Completeness**

=> A paragraph should be 3-5 sentences.

How to write a paragraph

- http://www.wikihow.com/Write-a-Paragraph
- https://owl.english.purdue.edu/owl/resource/606/01/
- http://www.time4writing.com/writing-resources/paragraph-writing-secrets/
- https://www.dlsweb.rmit.edu.au/lsu/content/4_writingskills/writing_tuts/paragraphs_ll/model.html
- https://prezi.com/ncugb7dhso8x/how-to-write-a-paragraph/

How to write a paragraph

BEFORE

Supernova remnants (SNRs) are a diverse and complex class of objects. They are the result of interactions of material ejected in a supernova with the ISM. As a consequence, the release of 1051 ergs of energy into the ISM produces shock waves. This heats and compresses the neighborhood of the progenitor. The compression, followed by radiative cooling can trigger star formation in dense clouds. The study of SNRs provides valuable information to stellar evolution, evolution of galaxies and interstellar medium.

AFTER

Supernova remnants (**SNR**s) are the end stage of a stellar evolution. SNRs are created following the explosion of a massive star. The process releases over 1000 ergs of energy into the interstellar medium (**ISM**), producing a shock wave. The shock wave then heats and compresses ISM, resulting in a shell of ionized plasma around the progenitor star. This shell is what we see as the SNR.

SNRs provide a valuable tool to study stellar evolution, the interstellar medium, and the evolution of galaxies themselves. For example, the compression stage SNR formation, followed by radiative cooling, can trigger star formation in dense clouds. These star formation regions provide a unique window into stellar evolution, courtesy of the SNR.

Things to keep in mind…

- Scientific documents are NOT novels!
  Do not try to be 'creative' here, by saving the best for last!
- Avoid being verbose! Say what you need to say, but don't "fill" the space unnecessarily.
- Don't plagiarize! Write the conclusions in your own words and cite the source. Alternatively, quote + cite.
- Write in complete sentences.

More suggestions for writing:

- Make sure you are saying what you THINK you are saying.
  Example: "Death by a gun is more lethal than death by a sword."
- Avoid using words over and over and over and over.... either abbreviate, or choose a different word.
- When summarizing the 'big picture', imagine you are out for coffee with me - Tell me what your research is about in 3 or 4 sentences.
- The US government plain language guidelines:

http://www.plainlanguage.gov/howto/guidelines/FederalPLGuidelines/TOC.cfm

Check your Spelling!

Rules for spelling

- Use the spell checker
- Use abbreviations/acronyms only if:
  - they are commonly used (take the time to define them!)
  - you use the abbreviation at least 3 times (otherwise, just spell it out fully!)
  - you define the acronym at the first usage of the word/phrase (I recommend 'bolding' it as well).
- Make sure you are using the correct homonym

Homonyms

- Definition:

  Words that sound the same, but mean different things.

- Commonly misused Homonyms:
  - Two / To / Too

    two = number; to = go ; too = also
  - You're / Your

    You're = you are; Your = possessive
  - They're / Their / There

    they're = they are; their = possessive ; there = location
  - It's / Its

    It's = it is; its = possessive

Homonyms can be punny!

- Be careful!

"The current research in galactic magnetism….".

Does *current* mean:

a) The flow of charges resulting in a magnetic field
b) The most recent research

Hard to tell!

Word Games…

- The word "Data" is actually plural. Therefore, you should write:
  - "The data are subject to further scrutiny..."
  - "The data have been processed..."
  - "The data were used to show..."

- Canadian English versus American English are different. In Canada, we traditionally follow the British spelling, but use American words…
  - Colour versus Color
  - Polarise verus Polarize
  - Line up versus Queue

- Affect versus Effect
  - Affect is something that is Applied (VERB)
  - Effect is the result (NOUN)

Punctuation

Things to keep in mind…

- Colon:

The colon is used to provide an example, or more detailed information in a sentence. It often appears after expressions including ***the following*** or ***as follows***, but NOT ***for example***, ***including***, ***such as***, or ***that is***.

- Semicolon:

The semicolon joins ideas that are related and equal in grammatical structure. It acts like a conjunction (and, but, or).

- Comma:

Commas are used to separate items in a series, or to set off introductory phrases, or introductory words (e.g., ***however***).

Things to keep in mind…

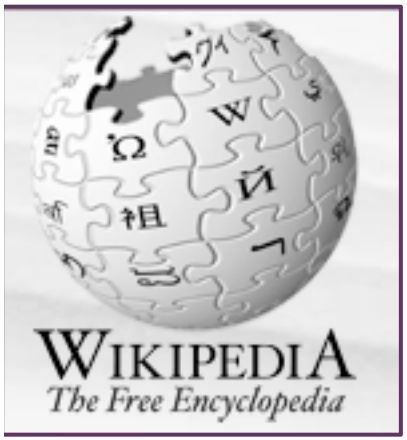
- More information on colons, semicolons, and commas.

http://leo.stcloudstate.edu/punct/col-semi.html
https://owl.english.purdue.edu/owl/resource/607/01/
http://theoatmeal.com/comics/semicolon

Person / Voice / Tense

Formal Writing Style - Person

The most important thing to remember about person is...
... be consistent!



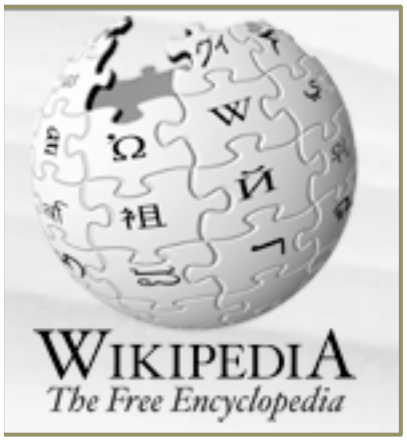
Person defines the languages set of personal pronouns and affects verbs, nouns and possessive relationships.

English has three grammatical persons.
First person: *I* (singular) or *We* (plural)
Second person: *You* (both singular and plural)
Third person: *He, She, It, They* (all else not referring to speaker or addressee)

I prefer first person for a thesis and for science writing.

Formal Writing Style - Voice

The most important thing to remember about voice is...
... be consistent!



The ***Voice*** of a verb describes the *relationship between the action and the participants* (identified by its arguments).

When the subject is the agent of the verb, the verb is in the active voice.

The cat ate the mouse - "ate" is active.

When the subject is the patient of the action, the verb is in the passive voice.

The mouse was eaten by the cat. - "was eaten" is passive.

Formal Writing Style: Voice and Person

Use a voice appropriate to your audience.

When writing a thesis, I recommend first person active.

Person

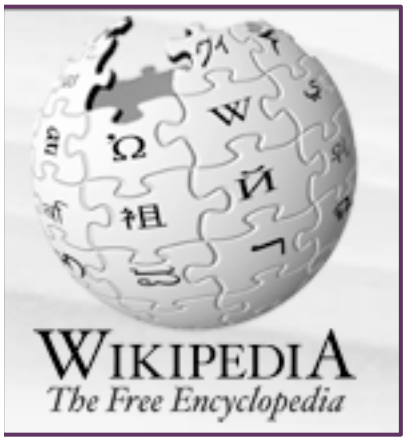
- First Person uses "I" or "We" when discussing the work
- Third person removes the author from the discussion.

Voice

- The voice can either be "active" or or "passive":
  - "Darwin formalized the concept of evolution".
    (third-person active)
  - "The concept of evolution was formalized by Darwin."
    (third-person passive)
  - "We took the observations over 3 nights in June".
    (First person active)
  - "The observations were taken by us for 3 nights in June."
    (First person passive)

Formal Writing Style - Tense

The most important thing to remember about tense is...
... be consistent!



Tense is one of at least five qualities, along with mood, voice, aspect, and person, which verb forms may express.

English has two tenses by which verbs are verbs are inflected: present tense, and past tense. The 'future tense' is indicated with a modal auxiliary, not verbal inflection.

There are languages like Chinese in which tense is not used, but implied in temporal adverbs when needed. Some languages, like Japanese, have the temporal information in the inflection of adjectives, lending them a verb-like quality.

Formal Writing Style - Tense

- Past tense:

"The authors discussed their future plans, which included..."

- Present tense:

"The authors discuss their plans, which include..."

- (Future tense):

"The authors will discuss their plans in a future paper."

Choose a tense and stick to it.

Usually, when writing a thesis or paper, past tense is employed:
We did this… I calculated that…

Formal Writing Style - Emphasis

- Scientific writing should be thoughtfully composed and controlled

- Avoid imparting excessive feelings or emotions
  - Do not use **bold**, *italics*, or larger font size for emphasis
  - Do not use exclamation points!!!
  - Do not use informal, exaggerated words
    - Really unusual
    - Awesome
    - Amazing
    - Very (especially “very unique”)

Formal Writing Style - Colloquialisms

- Not acceptable in formal writing:
  - Contractions
    Isn't (is not), it's (it is), can't (cannot)
  - Fillers
    Used at the start or end of a sentence to impart a conversational and friendly flow
    Well, Anyway, Like, Right, So,
    OK? see? Know what I mean?
  - Slang

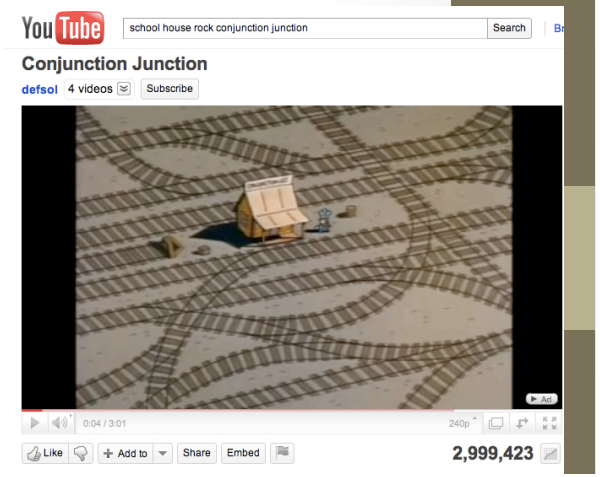
Formal Writing Style – Links…

- First person versus third person:
http://www.teachingandlearningresources.co.uk/person.shtml

- Active versus passive:
http://essayisay.homestead.com/passive.html

- Present versus past:
http://leo.stcloudstate.edu/grammar/tenses.html

- Conjunctions (remember: use semi-colons like conjunctions):
http://www.youtube.com/watch?v=RPoBE-E8VOc



Equations / Figures / Tables

Equations

- Treat equations as part of a sentence – be sure to include punctuation.
- EXPLAIN your equation; Don't just give it a title!
- Define ALL variables – even if it is "obvious". It gives the reader as sense of security.

Remember: The goal is to have the reader need to do as little work as necessary to understand you!

Figures and Tables

- Figure are worth 1000 words, but take up space.
  Make sure they are worth it!

- Captions:
  Number. Title. Details. Reference if necessary.

- **Every Figure and Table MUST be referred to in the text.**

- The Figure or Table should show up as close as possible to the first mention of the figure, or just after the relevant section.

- **Make sure there is a reference in the caption if you did not make the figure or table yourself.**

Citations!

Citing Literature

- Use the recent literature preferentially, but do cite the original (=first) papers in which ideas/results arose.
- Make sure that you read each paper, don't just cite them for what others say about them (others are often wrong).
- Be succinct when citing literature.

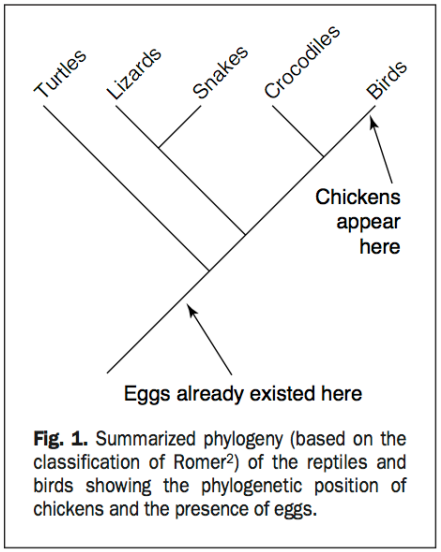


Fig. 1. Summarized phylogeny (based on the classification of Romer[2]) of the reptiles and birds showing the phylogenetic position of chickens and the presence of eggs.

- *Less-than-ideal:* Shykoff & Widmer (1998) performed a study showing that eggs came before chickens, resolving the age-old question.
- *Better:* Eggs came before chickens (Shykoff & Widmer 1998).

Citing Literature

- Avoid using the same reference over and over in the same paragraph (or even page).

- Cite appropriately!

Practice Quizzes

- http://www.englishgrammar.org/exercises/
- http://www.niu.edu/writingtutorial/punctuation/quizzes/PunctuationSelfTest.htm
- http://www.grammar-monster.com/tests/test_punctuation.htm

Fun Quiz…

Question

Fill in the blank:

There are many types of galaxies. _____ is a spiral galaxy.

a) Our's <= Page 1 of my PhD!

✔ b) Ours

c) There's

d) Their's

Walk-Away Points

- **Use the Magic 3!**
  - What is the topic?
  - Why is it important?
  - What did you do about it?
- **Remember the Three T's**
  - Tell them what you're going to tell them.
  - Tell them.
  - Tell them what you told them.
- **Keep your Audience in mind!**
  - Is [this] needed/relevant to the story you are trying to convey?
  - Make it clear!