Scientific Literature Review
Overview:

1. What is a Scientific Literature Review?
2. How to write a Scientific Literature Review
3. Key elements of a Coherent Literature Review
4. Literature Review Structure
What is a Scientific Literature Review?
A scientific literature review is a critical account of what has been published on a topic by accredited researchers.

It may be:

- A stand-alone assignment
- An introduction to an essay, report, thesis, etc.
- Part of research/grant proposals
Scientific Literature Review:

Writing a literature review will:

• Improve your topic **knowledge**

• Provide new **insight** on your topic to others

• Demonstrate your **literature searching** abilities

• Demonstrate your **critical analysis** skills

• Demonstrate your **communication/writing** skills

…*your lecturer will be marking you on these skills!*
Scientific Literature Review:

A scientific literature review is *not*:

- An English essay… use *scientific writing!*
- A **summary** of each research article that you read
- Based on personal opinion or **biased** towards your opinion
- A **chronological history** of events in your research area
Scientific Literature Review:

What is the purpose of a literature review?
What is the purpose of a literature review?

*Communication and advancement of scientific knowledge!*

- Scientific knowledge is not static: reviews help scientists to understand how knowledge in a particular field is changing and developing over time.

- There is a significant output of scientific publications – literature reviews save time for the scientific community.

- Literature reviews can lead to new scientific insights and highlight gaps, conflicting results and under-examined areas of research.
A scientific literature review should:

• Provide a **clear statement** of the topical area (scope)

• Provide a **range of research** on the topic – and not just the “good” data!

• **Critically analyse** a selected topic using a published body of knowledge (backed-up arguments)

• Provide an indication of what **further research** is necessary

• Identify areas of **controversy** in the literature
How To Write A Scientific Literature Review?
Scientific Writing!

...is writing about scientific topics aimed at specialists in a particular field

Assume the reader is familiar with the research/topic area but not with the specifics of your review…

i.e. your lecturer
    your Principal Investigator
    peer-reviewers (journal articles, research papers, book chapters, grant proposals)

*Use precision, clarity and objectivity!*
1. Be precise!

Ambiguities in writing cause confusion and may prevent a reader from grasping key concepts of your review…

- Use precise concrete language, no ambiguity
  eg ‘correlated’ ≠ ‘related’

- Exclude similes/metaphors (and humour!)

- Be quantitative wherever relevant (stats, numbers etc.)
Scientific Writing!

2. Be clear!

Concepts in the sciences can often be complex; without clarity the reader may be confused or misled

- Simple language – no unnecessary “frills” (distractions)
- Pay attention to sentence structure, grammar

*Your reader will be interested based on the science only... make it easy for them to access!*
Scientific Writing!

3. Be objective!

Any claims that you make need to be based on facts, not intuition or emotion

• Passive voice – focus is on the literature!

• Avoid assumptions or sweeping statements

• Be aware of research limitations and refer to these in the review
How to Write a Scientific Literature Review?

Reviewing the literature requires **four stages:**

1. **Problem formulation** - Which topic is being examined and why? What aspects will be included/excluded? Define your scope

2. **Literature search** - Identifying relevant research

3. **Critical analysis** – Criticise the experts; identify conflicting evidence, assumptions, errors and misconceptions

4. **Evaluation** – which authors are most convincing and provide the most significant scientific contribution? Have I conducted a fair and objective literature review?
1. Problem Formation

Ask yourself questions like these:

• What useful reviews are missing or not up to date in my research area?

• What new review topic would be useful to scientists?

• Is there a specific aspect of this topic that my literature review might help to define?

  eg. critically comparing different methodological approaches, contrasting evidence, assessing therapeutic potential, etc.

• What is the scope of my literature review? Be specific
Literature Searching…

1. Online Research (basic) – Background Information
   • Wikipedia (gasp!)
   • Relevant “background” websites (eg. university websites, company websites, associations eg. American Heart Association)
   • YouTube, TED Talks

2. General Literature Search – Literature Overview
   • Google Scholar/Books
   • PubMed
     …find other relevant literature reviews in the area to see what has been done/what is needed

3. Specific Literature Search – The Detail
   • Library databases e.g Web of Science
   • “Advanced search” tool in Google Scholar/PubMed
   • Identify key references for each topic of your review

TIP: Use the Library!
Library staff are always there to help if you have questions on literature searching.
3. Critical Analysis

In assessing each source, consideration should be given to:

- **Provenance** - Author’s credentials? Are the author’s arguments supported by evidence?

- **Objectivity** - Is the author’s perspective fair? Is contrary data considered? Is information ignored to prove the author’s point? (bias)

- **Persuasiveness** – Is the author’s data convincing?

- **Value** - Does the work contribute in a significant way to an understanding of the field?

...this involves CRITICAL THINKING!
What is critical thinking?

Cottrell (2016):
“The process of looking at ideas and information critically, taking nothing for granted, but questioning accuracy, motivation and inferences, and seeking new understanding, connections and insights.”

i.e. weighing up the evidence and arguments for or against something, and coming up with your own informed opinion.
Ask questions!

- “Is that really true?”
- How do you know?
- Show me the evidence.
- Is that evidence reliable?”

“There is evidence on both sides”

Keys to CRITICAL THINKING

- Recognize Assumptions
- Evaluate Arguments
- Draw Conclusions

Red Model based on the Watson-Glaser™ Critical Thinking Appraisal at www.ThinkWatson.com
Critical Thinking…

Move from **Description** to **Analysis**!

**Description** – reproducing information
- Summarising texts - accepting details, results etc.

**Analysis** – deconstructing information in order to:
- *Challenge* assumptions; perspectives
- Show *limitations* in studies, exceptions to cases
- Highlight *under-examined* aspects of research
Key aspects of critical thinking

• Identify evidence to **back-up AND challenge** key points

• Detecting **inconsistencies and mistakes** in authors’ reasoning

• Detecting **bias**, premature conclusions, lacking evidence

• Distinguishing between **fact and opinion**

• Evaluating **conflicting** opinions/research

• Suggesting new or different **solutions**

• Constructing **your own arguments and opinions**
What should I be asking?

- Why is the author choosing to use the evidence presented?
- Is there a hidden agenda? *(eg. financial gain)*
- Are the sources reliable and objective?
- Is there bias present?
- Have all of the points been cited?
- Is there information missing?
- Are there conflicting opinions/conclusions?

And most importantly…

- *Do I agree with these opinions/conclusions?*
Critical Thinking…

Critical Thinking is the key to a good grade...

…don’t be afraid to criticise the experts and show your understanding of the topic!

This is the most important aspect of a good literature review!
4. Evaluation and Interpretation

• What **conclusions** can I make from the most convincing literature? What are my opinions/arguments?

> Also evaluate **your own interpretations**…

• Have I made a well-informed decision? How good was my **information seeking**? Has my search been **wide** enough to ensure all relevant material is included? Has it been **narrow** enough to exclude irrelevant material?

• Have I **critically analysed** the literature I use?

• **Instead of just listing and summarizing research, do I assess them, discussing strengths and weaknesses?**

• Have I cited and discussed studies **contrary** to my perspective to form a well-balanced argument?
Coherent Scientific Literature Reviews
Coherent Scientific Literature Reviews

Aim for:

• **Clear and cohesive** essay that integrates the key details of the literature and **communicates your point of view**

• Tackle **one key point** at a time

• Use **subheadings**, especially in long reviews

• Check the **flow** of your argument for coherence (logical order?)

*...this is all about **STRUCTURE**!*
How to structure a scientific literature review?

- **Introduction:** An *overview* of the topic under consideration, along with the *objectives* of the literature review.

- **Main body:** Critical analysis, evaluation of topically relevant research/data; Break into *sub-headings*

- **Conclusion:** Summarise the *key points* from your review

Word count:

- Introduction = 10%
- Main Body = 80-85%
- Conclusion = 5-10%
Before you start writing…

1. **Brainstorm/plan your review**
   Allow 10% of your word count for each Introduction and Conclusion
   What are the key aspects of your review?

2. **Decide on the number of “topics” you will address based on your remaining word count (80%)**
   Of the most interesting/relevant topics… how many can you address in the allowed word count? Prioritise!

3. **Choose your topics**
   Scan the literature, make sure there is enough information out there for you to complete a coherent, critical summary of each chosen topic
1. Introduction

*It is usually easier to write this after the main body…*

Introduce your topic by highlighting the **core scientific facts** that are well backed up and widely accepted.

Highlight the **importance** of the review – are you assessing potential clinical relevance? Gap in research area? New perspective?

What is the **core aim** of this review? To compare and contrast conflicting evidence? To identify under-examined aspects of the topic?

Tell the reader **what you are going to talk about… list your topics in order!**
2. Writing the Main Body

• Group research topics according to common elements and back up main points with research

• Focus on recent data where possible – scientific fact changes/develops over time!

• Summarize individual studies or articles with as much or as little detail as is relevant – detail denotes significance!

• Tackle one key point per paragraph so as not to overwhelm the reader

• Use sub-headings to group your topics

• Use diagrams, figures, tables where appropriate
# Tackle 2-3 key points per section...

<table>
<thead>
<tr>
<th>Section</th>
<th>Sub-point 1</th>
<th>Sub-point 2</th>
<th>Sub-point 3</th>
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<tbody>
<tr>
<td><strong>INTRO</strong></td>
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<tr>
<td>10% of word count</td>
<td>Go from the broad to the specific. Introduce the general topic, why it is an important area, then state what you will specifically do to investigate it further.</td>
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<tr>
<td><strong>Section 1</strong></td>
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<td>Sub-point 1</td>
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<td><strong>Section 2</strong></td>
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<td>Sub-point 2</td>
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</table>

| **CONCLUSION** |            |            |            |
| 10% of word count | Go from the specific to the broad. State the conclusions you can draw from the points you’ve made in the essay, and connect this learning to the general topic. End by posing a question for future research in the field. |
…one key point per paragraph!

1. Topic Sentence
   • Start each topic with a strong “umbrella” sentence introducing your key point

2. Supporting Sentences
   • Provide context, examples or data
   • Each point backed up with a source/reference
   • Use “linker” words to introduce similar points
   • Opposing data should also be considered

3. Concluding Sentence
   • Include summary sentences at end of paragraphs… why this information is relevant
   • May link to following paragraph
1. Writing the Main Body

Agreement / Addition / Similarity

The transition words like also, in addition, and, likewise, add information, reinforce ideas, and express agreement with preceding material.

- in the first place
- not only ... but also
- as a matter of fact
- in like manner
- in addition
- coupled with
- in the same fashion / way
- first, second, third
- in the light of
- not to mention
- to say nothing of
- equally important
- by the same token
- again
- to
- and
- also
- then
- equally
- identically
- uniquely
- like
- as
- too
- moreover
- as well as
- together with
- of course
- likewise
- comparatively
- correspondingly
- similarly
- furthermore
- additionally

Opposition / Limitation / Contradiction

Transition phrases like but, rather and or, express that there is evidence to the contrary or point out alternatives, and thus introduce a change the line of reasoning (contrast).

- although this may be true
- in contrast
- different from
- of course ..., but
- on the other hand
- on the contrary
- at the same time
- in spite of
- even so / though
- be that as it may
- then again
- above all
- in reality
- after all
- but
- (and) still
- unlike
- or
- (and) yet
- while
- albeit
- besides
- as much as
- even though
- although
- instead
- whereas
- despite
- conversely
- otherwise
- however
- rather
- nevertheless
- nonetheless
- regardless
- notwithstanding
Critical Phrases...

http://www.phrasebank.manchester.ac.uk/

Identifying a study’s weakness

Smith fails to fully define what...
Jones fails to acknowledge the significance of...
the author overlooks the fact that X contributes to Y.
what Smith fails to do is to draw a distinction between...
the paper would appear to be over-ambitious in its claims.
another weakness is that we are given no explanation of how...
no attempt was made to quantify the association between X and Y.
the main weakness of the study is the failure to address how...
the study fails to consider the differing categories of damage that...
the research does not take into account pre-existing ... such as...
the author offers no explanation for the distinction between X and Y.
Smith makes no attempt to differentiate between different types of X.
2. Main Body: Figures/Tables

- Aim for one key figure/table per section; this can be to:
  - illustrate a complex concept
  - summarise a large body of relevant data
  - describe the order of a process (flow diagrams)

- Legend below image/figure and above table

- Always refer to figures/tables in text… direct the reader to them (as seen in Figure 1; as summarised in Table 1)

- Provide a detailed legend… each figure + legend should stand in its own right without the review text

- Figures and tables provide a break for the reader and a chance to understand and reflect on key concepts!
Writing the Conclusion

- Maintain the focus established in the introduction
- Summarise major research contributions to the scientific field (most convincing data) and make your point of view clear
- Point out major flaws/gaps/inconsistencies in research
- Highlight potential future studies
- Provide closure so that the path of the argument ends with a conclusion of some kind

NOTE: A literature review in a thesis or dissertation usually leads to the research questions that will be addressed.... 4th Year students!
Additional Sections….

• Usually, a short **ABSTRACT** (approx. 200 words) is required before your literature text to summarise the topics, main findings and conclusions from your review

• *This tells the reader exactly what your review contains so that they can make an informed decision - if it is relevant or not - before reading the full text*

• **TABLE OF CONTENTS** – show the reader where to find the relevant information

• **ACKNOWLEDGEMENTS** – acknowledge any funding bodies/research groups that contributed to the review writing process

• **CONFLICT OF INTEREST** – you must declare if the *primary interest* of your review may be affected by any *secondary interests* (personal benefit)
Revising & Editing

Voice – passive voice? Target audience?
Cohesion – sentence length/clarity?
Criticality – clear critical thinking?
Referencing – have I referenced where appropriate?

Grammar – Grammarly!
Mechanical issues – sentence length, spelling, punctuation

Ask peers/family members – get second/third/fourth opinion!
Read out loud - Claroread
Give yourself a break – Fresh eyes!

YOU HAVE PUT IN SO MUCH TIME ALREADY....

....MAKE IT PERFECT!!!
Referencing

It is essential to credit published papers for work mentioned in your manuscript...

• In-text
• Reference List/Bibliography – what is the difference?

“atherosclerosis has been claimed to be an independent risk factor for cardiovascular death (Detrano et al., 2008).”


Harvard referencing guide…. CiteThemRight…. Zotero referencing manager…

Mendeley/RefWorks – other options

Do the library workshops!!
Referencing

Figures/Tables:
• In-text citation in the figure legend after description
• May need to ask for permission from the publisher – be careful! *(is the image copyrighted?)*
• If figure is adjusted: “image adapted from [source]”

MAKE SURE YOU REFERENCE THE SOURCE MATERIAL (original research paper, where appropriate) and NOT A REVIEW OF THE RESEARCH

Except when you are referencing another reviewer’s opinion/critique etc.

• Avoid plagiarism… use quotation marks for direct quotes + “in-text” citation
• Use “in-text” citation only to reference ideas/opinions/indirect quotes
Example: Published Review...

Concise, informative title

Sub-headings

Short abstract – 200 word summary

Table of Contents

Good paragraph length to clearly analyse key topics
Example: Published Review...

Fully delineated, and alongside these reports, additional studies point to the involvement of three specific glycoproteins: OPC, RANKL, and tumor necrosis factor-related apoptotic-inducing ligand (TRAIL). The following sections will examine the evidence for involvement of these proteins within the VSC process, including proposed cellular mechanisms arising from in vitro and animal study models.

4. VC — OPC, RANKL, and TRAIL

There are numerous molecular components to the VC signalling cascade, described in detail by Sage and colleagues [40], which are relevant to bone morphogenesis. There is growing evidence that the interaction of OPC, RANKL and TRAIL with VSMC may be central to VC formation [37].

OPC, RANKL, and TRAIL are all involved in the activation of vessels by inducing osteoclastic activity [27]. RANKL, when bound by osteoclasts, can lead to the RANK receptor to promote pathologics differentiation of human VSMCs into activated VSMCs with an osteoclast-like phenotype [27, 42]. This suggests that RANKL is upregulated and its calcified VSMCs [42] and has been shown to exert its pre-calibration actions through activation of the alternative NF-κB pathway [72].

Thus, when upregulated in osteoclasts, inactivation of osteoblasts may result in osteoclastic activity. RANKL, an anti-apoptotic effect RANKL and OPC are crucial in calcifying bone remodelling. Inhibition of RANKL has yet to be fully understood.

Interestingly, a third regulatory protein, TRAIL, has been shown to interact with OPC and RANKL during modulation. If the VC process [44], although its precise function is not yet fully described. In this regard, emerging hypothesis within the field has proposed this vascular system, which may contribute to explaining the apparent contradictions within TRAIL function. Overall, there is evidence to suggest that TRAIL has a substantial role in the pathogenesis of VC, both independent and dependent of OPC and RANKL.

**Clear summary table and table legend**

**Informative/relevant image and figure legend**
Example: Published Review...

Concluding with key points and future work

Lengthy reference list

Relevant acknowledgements
QUESTIONS
???
Acknowledgements

This presentation was prepared based on the resources kindly made available online by:

- University of Santa Cruz
  http://guides.library.ucsc.edu/c.php?g=119714&p=780881
- University of Toronto
  http://www.writing.utoronto.ca/advice/specific-types-of-writing/literature-review
- University of Minnesota Duluth
  http://www.duluth.umn.edu/~hrallis/guides/researching/litreview.html
- The University of Wisconsin - Madison Writing Centre
  http://writing.wisc.edu/Handbook/ReviewofLiterature.html
- Monash University