Year 11 Chemistry

Mini Guide

Breaking down the Claim
Researching
Writing

CHEMISTRY FUNDAMENTALS
MOLECULAR INTERACTIONS AND REACTIONS
# Table of Contents

The Aims of Your Research ........................................................................................................3  

Step 1: Find a Scientific Journal Article ..................................................................................3  
   A. Prepare to Search .................................................................................................................3  
   B. Finding your Article ..............................................................................................................4  
   Broad Background Reading .......................................................................................................4  
   Narrow Research ......................................................................................................................4  
   C. Article Data ..........................................................................................................................4  
   D. Research Question .................................................................................................................4  

Step 2: Do Background Research ..............................................................................................5  
   1. Follow the Trail .....................................................................................................................5  
   2. Spotlight ...............................................................................................................................5  
   3. Saturation ..............................................................................................................................5  

Step 3: Find Secondary Data .....................................................................................................6  
   Datasets .....................................................................................................................................6  
   Boolean Operators are your friend ............................................................................................6  
   Important Tips ............................................................................................................................6  

Incorporating and using evidence ............................................................................................7  

Rationale ......................................................................................................................................8  
   Sample Rationale ......................................................................................................................8  

Writing with Precision ...............................................................................................................9  

Word Choice ..........................................................................................................................10
The Aims of Your Research

Step 1: Find a Scientific Journal Article
Find a journal article on which to base your research question (it must include data).
   a) Break down the claim.
      a. Follow the Prepare to Search steps below
   b) Find an article that matches the claim (i.e. an infectious disease that has been reduced by some kind of technology).
   c) Make sure this article has some kind of data that you can use (numbers!)
   d) Form your research question (using the article).

A. Prepare to Search
1. Break down the claim
   EXAMPLE
   • **Chemistry of the ocean** is affected by **pollutants**.

2. Brainstorm the claim
   **Brainstorm definitions** of the key terms within your claim. See the Research Guide for some suggestions.

3. Question the key elements
   **Complete background reading to get a feel of your topic.** Here is where you become familiar with the key concepts so you can easily identify them to determine if an article or report will be useful for study. **Start with your textbook.**

   **BROAD EXAMPLE QUESTIONS:**
   • What is the chemical composition of the ocean?
     o Britannica: chloride (Cl\(^-\)), sodium (Na\(^+\)), sulfate (SO\(_24^-\)), magnesium (Mg\(_2^+\)), calcium (Ca\(_2^+\)), and potassium (K\(^+\)), carbon, bromide, boron, strontium, and fluoride, phosphorus and nitrogen
   • What pollutants have the ability to change ocean chemistry?
     o CO\(_2\)
   • What part of the ocean’s composition is vulnerable to pollutants?
     o pH
   • How is the ocean effected by pollutants?
     o Eutrophication
     o Ocean acidification due to the absorption of carbon dioxide is an emerging environmental problem

4. Brainstorm or note-take
   Represent your ideas and the key concepts from your background reading in a graphic form.

5. Use these ideas and questions to guide your research
   The key is to start broad and narrow your focus as you research.
B. Finding your Article

Broad Background Reading

Start with reading a suggested background reading article from the Research Guide.

* It is crucial you have a solid, broad understanding of the topic before you start to look for specific research.

Suggested sites for background reading

- Option 1: Union of Concerned Scientists from MIT: [https://www.ucsusa.org/](https://www.ucsusa.org/)
- Option 2: Science News for Students: [https://www.sciencenewsforstudents.org/](https://www.sciencenewsforstudents.org/)
- Option 3: The Conversation: [https://theconversation.com/au](https://theconversation.com/au)

Narrow Research

Once you have an idea about the chemical interaction or reaction you would like to investigate, start your targeted research using databases such as Gale, EBSCO Discovery Service, State Library OneSearch, and Google Scholar.

Make use of Boolean Operators to help narrow or broaden your search query.

- Helpful tips for using Boolean Operators are on page 6 of this guide.

C. Article Data

- Make sure your chosen article has some kind of data that you can use (numbers!) and that relates back to the claim.

D. Research Question

- Form your research question (using the article).
Step 2: Do Background Research

So, you have found and read your research article you now need to do some reading to become an expert in this specific field.

1. Follow the Trail
   Search for your topic or key words on Google and within online periodicals such as The Conversation and New Scientist.

   REFLECT: Can I find any information that supports what I have previously read?
   - If NO: Try using different search terms or broaden your search. Try using the search terms in another search engine or website.
   - If YES: Good. You’re on the right track. Take notes about the topic. What are the key areas, theories, or principles? Record the reference information – you may want to come back to this later or use it in your rationale. Use this information to guide your next phase of research.

2. Spotlight
   Have you found what seems to be a really helpful article?

   Can you mine the reference list?
   - Mining the reference list means looking up the sources the article refers to. Are they useful for your research? Do they provide data or links to data?

   Can you follow the claim upstream?
   - Can you follow hyperlinks included in the article?

   Can you triangulate the claim?
   - Can you find another source that supports or refutes the claims made in the article?

3. Saturation
   Continue with your search until you have found enough information to support your claim. You know when to stop when you have reached knowledge saturation. You have everything you need and you’re only finding information that repeats what you already have.
Step 3: Find Secondary Data
This data can be used to corroborate (back up) the data in your article. This data can be found in Datasets but only in other journal articles.

Datasets
Before you get to the datasets, you must know what you are looking for or have an idea of the terminology, pathogens, chemical or biological abbreviations, or phenomena you are looking for. Most datasets are very academic and use very technical language.
- It might be wise to first look for data through Google Images and follow the trail.
- Find a graph or table of data that is related to your topic and locate the source of information.
- Use the dataset links on the Research Guide as a starting point.

Boolean Operators are your friend
Remember to use these useful Boolean phrases when searching. These can take your search results from the millions to the hundreds (or less)
- “” : searches for the exact phrase, or else some search engines will split the phrase up into single word components.
- * : the database (won’t usually work with Google) will return and highlight any word that begins with the root/stem of the word truncated by the asterisk.
  - E.g. admin* with return results such as administrator, administration, administer, administered.
- And: combines search terms so that each search result contains all of the terms.
- Or: combines search terms so that each search result contains at least one of the terms. Put brackets around the words to group the options.
  - E.g. (disease OR illness)
  - (“strong force” OR “nuclear force”)
- Not: excludes terms so that each search result does not contain any of the terms that follow it.

Not sure what search terms to use?
Use the answers gathered from your background reading and key words from your task sheet. Also, use the key terms on the Research Guide.

Important Tips
- Read from the outside-in. Don’t waste your time reading through a lengthy study if it isn’t relevant. Just read the Abstract – It will be summary of the entire paper, including Aim, method, results, conclusions.
- Keep a record of your notes and references as you go.
  - Sign up to Diigo – annotate and save online
- Remember to be flexible in your searching.
  - If you are struggling to find information, change your article.
  - If you are struggling to write enough words, change your article or find more corroborating data.
Incorporating and using evidence

MAKING A CLAIM/DRAWING A CONCLUSION (RESEARCH REPORT)
A statement or conclusion that addresses the research question and links to the claim.

Sentence Starters

- This study shows that ___________ because ___________.
- ___________; therefore, ___________.
- The evidence suggests that ___________.
- If ___________ then ___________.
- ___________ is supported by the evidence in the study by __________ et al. (20__).

Counter claim:

- Another study by __________ et al. (20___), however, reported that __________.
- While ___________, it can be seen that ___________.

A statement or conclusion that answers the original question/problem.

Sentence Starters

- This evidence suggested that ___________ (identify what happened) when ___________.
- A comparison was made between ___________ and ___________ by ___________ (identify the action/process/method).
- The effect of ___________ on ___________ is ___________.

EVIDENCE
The scientific data that answers the research question:

Data are observations or measurements OR results from an experiment.
Numbers and data table information.
Research findings, principles and theories.

Sentence Starters

- In the data ___________.
- The evidence indicates ___________.
- ___________ (statement or claim) is clearly supported by ___________ (evidence).
- Based on ___________, it is apparent ___________.
- It is hypothesised ___________ based upon ___________.
- According to (specific person), ___________.
- In fact, (specific person) states ___________.
- Further evidence that supports this was reported in a study by ___________ who suggests ___________.

REASONING
Explains why the evidence answers the research question, providing a logical connection between the evidence and claim. A justification that connects the evidence to the research question.

Sentence Starters

- Based on the evidence, it can be concluded ___________ because ___________.
- Since ___________, that means ___________.
- The ___________ is determined by ___________ (include appropriate scientific principles).
- ___________ (scientific explanation for a phenomena), which is why ___________ (the phenomena happens).
Rationale

A scientific rationale provides a reason, based on your background research, that a particular research question is chosen. A rationale is simply your justification of the topic you chose. It explains why the research was performed in the first place.

You may ask yourself the following questions in order to compose the rationale:
(Think broadly first then bring the issue into focus.)

• What is the issue? Why is it important?
• Why is there a need to conduct the study?
• Consider the science behind the claim.
• How should the issue be resolved?

! You need to show how you got from your claim to your specific research question. Show the in-between steps. Use background research to show the links between each step.

Research Rationale

• Your rationale provides a reason, based on supporting scientific evidence, that your particular question was chosen.

Define and explain the different elements of the claim. Then, identify and describe key research and/or theories surrounding the claim. You must then establish your research question based on the claim and identify what the implications will be if your question proves to be correct.

Sample Rationale THIS IS A MODEL ONLY– IT DOES NOT ANSWER YOUR CLAIM

Body care products company Australian Biologika market their shampoo and conditioners as ‘caring for yourself ... without the dangers of harmful chemicals ... thus improving your health...’. (Buy Organics Online, n.d.) The chemicals in the Biologika shampoo are claimed to be all natural and from organic sources. This would suggest that shampoos containing synthetic chemicals are in fact more toxic or damaging to the body. The most common reaction that people have to shampoos and other cosmetics is contact dermatitis (Seidu, 2016). This can result in redness of the skin, scaly and itchy patches, burning sensations, as well as other effects. Several sources (SLS Free, n.d.) claim that the irritation is due to the presence of sodium lauryl sulfate, a surfactant found in shampoos. It is the surfactant that cleans the hair. Natural surfactants are found in yucca extract, soapwort and Quillaja bark extract.

Ultimately, a shampoo needs to clean dirty hair; however, this is only one aspect to consider when deciding which shampoo to purchase. To determine whether a shampoo is effective at cleaning hair, it is essential to understand how the surfactants in a shampoo clean the hair and alter the properties of water to allow for cleaning to occur.
Writing with Precision
How to reduce unnecessary words and phrases

Below is an example of a student’s work. Below that is an example of how a teacher has re-stated the exact same information but in a more concise manner. This has improved the response not diminished it.

**Student’s work**
One of the important benefits of fire is in forestry, where fires often aid in the regeneration of forests. A proposition was made by Smith et al. (2009) that indicated that the frequency of brushfires was correlated with the number of melaleuca trees saplings in the area. These saplings are important as they provide eucalyptus oil which is the second largest horticultural sector in Australia. The eucalyptus oil industry is a significant contributor to the Australian export market.

**Re-stated**
Forests benefit from the regenerating effects of fire. Smith et al. (2009) indicated that brushfire frequency was correlated with melaleuca sapling density. These saplings produce eucalyptus oil. The eucalyptus oil industry is the second largest horticultural sector in Australia and contributes significantly to our export market.

Selecting words carefully and omitting any unnecessary words can eliminate wordiness. Here are some examples of common changes:

<table>
<thead>
<tr>
<th>Wordy</th>
<th>Concise</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the problems</td>
<td>One problem</td>
</tr>
<tr>
<td>In only a very small number of cases</td>
<td>Occasionally, rarely</td>
</tr>
<tr>
<td>An additional piece of evidence that helps to support this hypothesis</td>
<td>Further evidence supporting this hypothesis</td>
</tr>
<tr>
<td>In spite of the fact that knowledge at this point is far from complete</td>
<td>Although present knowledge is incomplete</td>
</tr>
<tr>
<td>It is also worth pointing out that</td>
<td>Omit</td>
</tr>
<tr>
<td>Before concluding, another point is that</td>
<td>Omit</td>
</tr>
<tr>
<td>It is interesting to note that</td>
<td>Omit</td>
</tr>
</tbody>
</table>
**Word Choice**

**Words to help say what things are made of:**
- Consists of
- Is composed of
- Is made up of
- Is comprised of
- Is constructed of (with)

**Words to help compare things:**
- Less/more
- The same as
- On the other hand
- The least
- Whereas
- The same number as
- The most
- Unlike
- In contrast
- Like/ likewise
- Dissimilar
- However
- Similarly
- Although
- The equivalent of
- Equally/equal to
- Alternatively
- Identical
- Matching
- Different
- Parallel

**Words and ways to help talk about cause and effect (or actions and results):**
- Because (of)
- Produces/ is produced
- Accounts for
- As a result (of)
- Forms
- Is formed
- On account of
- Consequently
- Creates/ is created
- Due to
- Leads to
- Results in
- Owing to
- Causes
- Brings about
- When
- Makes
- Gives rise to

**Words to help talk about unexpected outcomes:**
- Even though
- However
- But
- Yet
- Despite
- Although
- Nevertheless,
- In spite of
- On the contrary