

**Research PAPER**

**Prep pack**

## RESEARCH PAPER PREP PACK

All items in yellow highlighting are sections you need in your paper.

Guiding / Outline questions are in light purple

Formatting tips and directions are headed in light blue.

Rubrics for each section are headed in light green

Peer Review Questions are in light red.

1. [Quick guide](#)
2. [PAPER TEMPLATE STS / WESEF APPROVED](#)
3. [Sample papers](#) (note: some are formatted for STS some for JSHS)
4. [APA style and citation guide](#) / [IEEE formatting link](#)
5. [BLANK APA PAPER TEMPLATE](#)
6. [FIGURE AND TABLE HELP](#)  
[Tables and Figures](#): links and [Checklist](#) And a [diagram of a figure](#)
7. [title help](#)
8. [Abstract Help](#), [Abstract Samples](#) ap class
9. [Introduction](#)
  - a. [intro narrative](#)
  - b. [review of lit](#)
  - c. [problem, goal, hypothesis](#)
10. [Methods](#)
11. [Results and Discussion](#)
12. [Conclusion Bookmark and Application](#)
13. [Future Research](#)
14. [Works Cited](#)

## Rubrics

1. [Introduction](#)
2. [Methods Non- Survey](#)
3. [Methods Survey](#)
4. [Results and Discussion and Conclusion and Application](#)

Helpful resources:

[video on outlining paper](#)

# Headings to Use

**List of tables and Figures**

**Abstract**

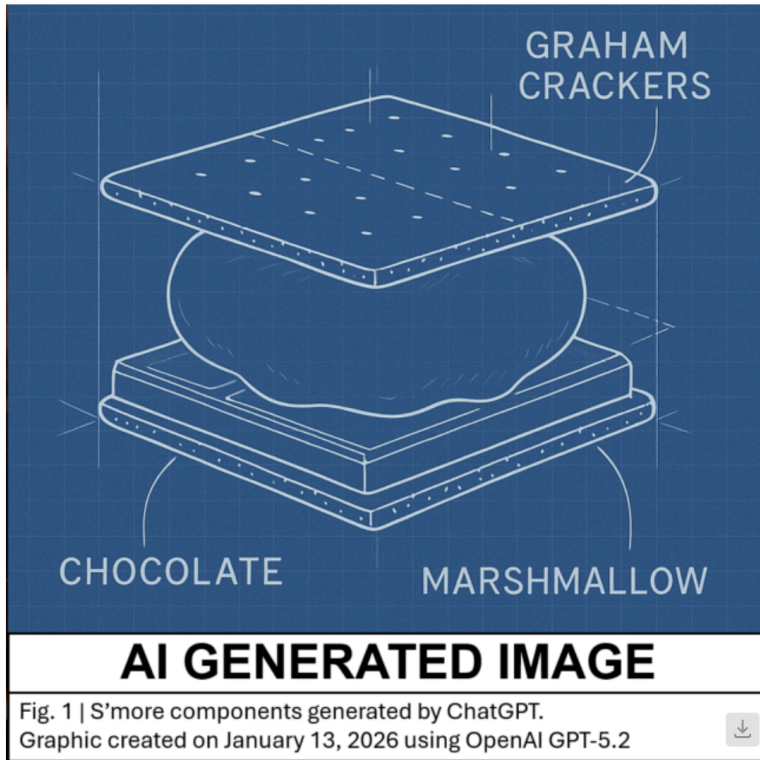
**Introduction**

**Review of Literature**

**Any Subheadings needed**

## QuickGuide

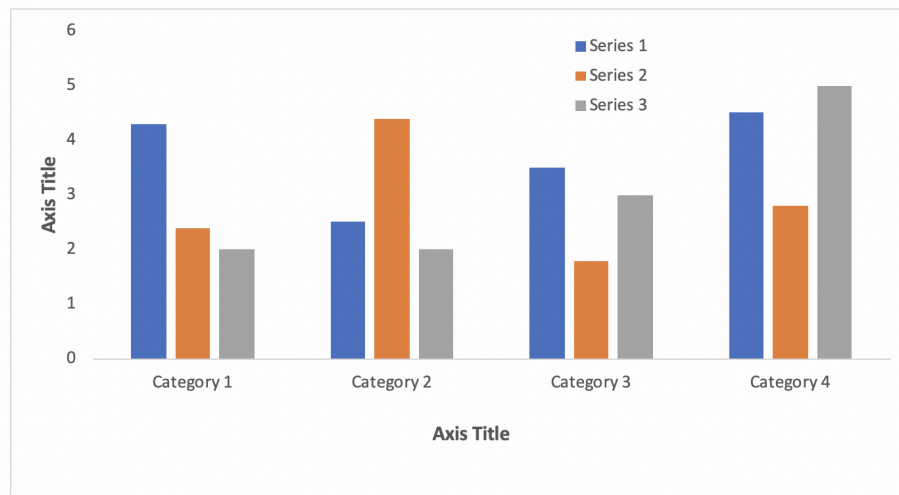
1. about 20 pages
2. about 15 works cited
3. use APA style
4. number each table (title it and caption it)
5. number each figure (title it and caption it)
6. Sections you need:
  - ☐ Cover page,
  - ☐ abstract,
  - ☐ introduction,
  - ☐ review of literature (ROL),
  - ☐ problem, goal, hypothesis (PGH),
  - ☐ methods,
  - ☐ results and analysis,
  - ☐ conclusions
  - ☐ Future research
  - ☐ works cited
7. peer review it
8. make a rough draft
9. [Tables and figures help](#)



Figures and tables

**Figure 1**

*Sample Figure Title*



*Note.* A note describing content in the figure would appear here.

## PARTS OF A FIGURE

### Numbers

All figures that are part of the main text require a number using Arabic numerals (Figure 1, Figure 2, etc.). Numbers are assigned based on the order in which figures appear in the text **and are bolded and left aligned.**

### Title

*Under the number, write the title of the figure in italicized title case.* The title should be brief, clear, and explanatory, and both the title and number should be double spaced.

### Image

The image of the figure is the body, and it is positioned underneath the number and title. The image should be legible in both size and resolution; fonts should be sans serif, consistently sized, and between 8-14 pt. Title case should be used for axis labels and other headings; descriptions within figures should be in sentence case. Shading and color should be limited for clarity; use patterns along with color and

check contrast between colors with free online checkers to ensure all users (people with color vision deficiencies or readers printing in grayscale, for instance) can access the content. Gridlines and 3-D effects should be avoided unless they are necessary for clarity or essential content information.

### **Legends**

Legends, or keys, explain symbols, styles, patterns, shading, or colors in the image. Words in the legend should be in title case; legends should go within or underneath the image rather than to the side. Not all figures will require a legend.

### **Notes**

Notes clarify the content of the figure; like tables, notes can be general, specific, or probability. General notes explain units of measurement, symbols, and abbreviations, or provide citation information. Specific notes identify specific elements using superscripts; probability notes explain statistical significance of certain values.

**Table 1*****Title***

| Stub<br>Heading | Column Spanner    |                   | Column Spanner    |                   |
|-----------------|-------------------|-------------------|-------------------|-------------------|
|                 | Column<br>Heading | Column<br>Heading | Column<br>Heading | Column<br>Heading |
| Table Spanner   |                   |                   |                   |                   |
| Row 1           | 123               | 234 <sup>a</sup>  | 456               | 789               |
| Row 2           | 123               | 987               | 543               | 876               |
| Table Spanner   |                   |                   |                   |                   |
| Row 3           | 432               | 567               | 543               | 908               |
| Row 4           | 256               | 849               | 407*              | 385               |

*Note.* This is a general note, referring to information about the entire table. Notes should be double spaced.

<sup>a</sup>Specific notes appear in a new paragraph; further specific notes follow in the same paragraph.

\*A probability note appears in a new paragraph.

\*STATISTICAL Stars

**Symbol    Meaning**

ns             $P > 0.05$

\*              $P \leq 0.05$

\*\*             $P \leq 0.01$

\*\*\*           $P \leq 0.001$

\*\*\*\*          $P \leq 0.0001$  (For  
the last two  
choices only)

## ELEMENTS OF TABLES

### Numbers

Number all tables with Arabic numerals sequentially. Do not use suffix letters (e.g. Table 3a, 3b, 3c); instead, combine the related tables. If the manuscript includes an appendix with tables, identify them with capital letters and Arabic numerals (e.g. Table A1, Table B2).

### Titles

Like the title of the paper itself, each table must have a clear and concise title. Titles should be written in italicized title case below the table number, with a blank line between the number and the title. When appropriate, you may use the title to explain an abbreviation parenthetically.

*Comparison of Median Income of Adopted Children (AC) v. Foster Children (FC)*

### Headings

Keep headings clear and brief. The heading should not be much wider than the widest entry in the column. Use of standard abbreviations can aid in achieving that goal. There are several types of headings:

- **Stub headings** describe the left hand column, or **stub column**, which usually lists major independent variables.
- **Column headings** describe entries below them, applying to just one column.
- **Column spanners** are headings that describe entries below them, applying to two or more columns which each have their own column heading. Column spanners are often stacked on top of column headings and together are called **decked heads**.
- **Table Spanners** cover the entire width of the table, allowing for more divisions or combining tables with identical column headings. They are the only type of heading that may be plural.



# Creating a Title

## 1. What is a "good" title?

(source: <https://guides.lib.uci.edu/c.php?g=334338&p=2249904>)

The title will be read by many people. Only a few will read the entire paper or study the content on a poster, therefore all words in the title should be chosen with care.

Too short a title is not helpful to the potential reader. However too long a title can sometimes be even less meaningful. Remember a title is not an abstract.

- The title should be clear and informative, and should reflect the aim and approach of the work.
- The title should be as specific as possible while still describing the full range of the work. Does the title, seen in isolation, give a full yet concise and specific indication of the work reported?
- Do not mention results or conclusions in the title.
- Avoid: overly clever or punny titles that will not fare well with search engines or international audiences; titles that are too short to be descriptive or too long to be read; jargon, acronyms, or trademarked terms.
- Include the fewest possible words that describe the contents of the paper/poster.
- Avoid waste words like "Studies on", or "Investigations on" (those are too vague).
- Use specific terms rather than overly general terms
- Watch your word order and syntax (structure)
- Avoid abbreviations and jargon

## 2. Questions to ask yourself

(source: *The Research Foundation of State University of New York, 2003*)

- What are you trying to find out? “*The Effect of* (independent variable) *on* (dependent variable) *in* (organism studied).”
- A statement of what is being investigated that should include the independent variable, the dependent variable, and the organism being studied. For example: “*The Effect of Fertilizer on Tomato Plant Height*”

## 3. Format for writing the title

(source: <https://apastyle.apa.org/style-grammar-guidelines/capitalization/title-case>)

- “Major” words are capitalized, and most “minor” words are lowercase. In sentence case, most major and minor words are lowercase (proper nouns are an exception in that they are always capitalized).
- **major words:** Nouns, verbs (including linking verbs), adjectives, adverbs, pronouns, and all words of four letters or more are considered major words.
- **minor words:** Short (i.e., three letters or fewer) conjunctions, short prepositions, and all articles are considered minor words.
- **Ex.** “*Turning Frowns (and Smiles) Upside Down: A Multilevel Examination of Surface Acting Positive and Negative Emotions on Well-Being*”

## 4. Additional resources:

- <https://libguides.usc.edu/writingguide/title>

- <https://www.enago.com/academy/write-irresistible-research-paper-title/>
- <https://www.saddleback.edu/faculty/thuntley/bio3a/labs/How%20to%20Write%20Scientific%20Paper%20Titles.pdf>
- <https://library.sacredheart.edu/c.php?g=29803&p=185911>

# Writing Your Abstract

*Goal:* Writing your abstract to catch the reader's interest.

*Rules for most abstracts:*

- Always in past tense
  - 250 words maximum
  - Only use "We" or "I" or "Me" or "My" if first person is used in your journal articles
  - "A", "I" count as words
  - Numbers count as words (examples 3 = one word, 35 = one word)
  - Symbols count as words (examples → = one word - +/- = one word)
  - Punctuation does not count as words
- 

*Understanding what an abstract is.*

The thought sequence for writing abstracts is totally different from that of a scientific paper or oral presentation. Knowing how to write a 250-word abstract is one of the most challenging areas of science research. Scientists write journal articles and present their papers and posters at meetings to inform others of their research. "Abstracts" provide the reader in one possibly two good paragraphs WHAT is the problem, WHY it was important, WHAT you did, WHAT you found, WHAT it means and WHAT is next.

The thought sequence is often totally different from that of the paper or oral presentation.

**Your abstract should provide a full overview in the shortest amount of time.**

*Step 1.*

Analyze each of the following and jot down a few notes on each area

1. Background info:  
*One sentence identifying the problem*
2. Why you did it  
*One sentence identifying the importance.*
3. What you did to address the problem: *2-4 sentence summary of methods explaining how your research addressed both the basic and the more specific problems. Basically, what you did and why.*
4. What you found and what it means  
*3-5 sentences explaining what your results were (past tense) and what they mean (present or future tense), in that order. Be extremely specific and clear.*
5. Future research:  
*1-2 sentences highlighting what the next step is and why.*

This page should be formatted in this way (especially for JSHS- you will need to save it as a single doc in PDF form for me to upload by itself)

**Title in Bold**

Your First and Last name

Body of Abstract

## APA STYLE and Citation Guide

# 2. APA Referencing Basics: In-Text Citation

In-text references must be included following the use of a quote or paraphrase taken from another piece of work.

In-text citations are citations within the main body of the text and refer to a direct quote or paraphrase. They correspond to a reference in the main reference list. These citations include the surname of the author and date of publication only. Using an example author James Mitchell, this takes the form:

Mitchell (2017) states... Or ...(Mitchell, 2017).

The structure of this changes depending on whether a direct quote or parenthetical used:

- Direct Quote: The citation must follow the quote directly and contain a page number after the date, for example (Mitchell, 2017, p.104). This rule holds for all of the variations listed.
- Parenthetical: The page number is not needed.

 **APA style**

**<https://www.easybib.com/guides/citation-guides/apa-format/>**

# APA Format Citation Guide

This is a complete guide to APA (American Psychological Association) in-text and reference list citations. This easy-to-use, comprehensive guide makes citing any source easy. Check out our other citation guides on [MLA 8](#) and [Harvard](#) referencing.

## Core Components of an APA Reference:

### Author Rules:

1. Initials are separated and ended by a period eg Mitchell, J.A
2. Multiple authors are separated by commas and an ampersand eg Mitchell, J.A., Thomson, M., & Coyne, R
3. Multiple authors with the same surname and initial: add their name in square brackets eg Mendeley, J. [James].

### Date Rules:

1. Date refers to date of publishing
2. If the date is unknown 'n.d' is used in its place eg Mendeley, J.A. (n.d)

### Title Rules:

1. The format of this changes depending on what is being referenced.

Author's surname, initial(s). (Date Published). Title of source. Location of publisher: publisher. Retrieved from URL

### Publisher Rules:

1. If in the US: the city and two letter state code must be stated eg San Francisco, CA
2. If not in the US: the city and country must be stated eg Sydney, Australia

This is used if the source is an online source.

# *APA General Formatting rules:*

[https://owl.purdue.edu/owl/research\\_and\\_citation/apa\\_style/apa\\_formatting\\_and\\_style\\_guide/apa\\_headings\\_and\\_serialization.html](https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/apa_headings_and_serialization.html)

## **Heading Levels**

Headings clarify your logic and organization for the reader by establishing a hierarchy of sections in the paper. **The most important thing to keep in mind is that "all topics of equal importance have the same level of heading throughout a manuscript"** (APA, 2010, p. 62).

Note that **title case** means only the first letters of words with four or more letters are capitalized, while all other letters are left lower case.

**Sentence case** means that only the **first** word of a title is capitalized, while all other letters are left lower case.

Use Level 0 heading (or title heading) formatting for the References heading of your reference list.

Here is the formatting for all APA heading levels:

Title [Level 0 heading: centered, not bolded, title case—also used for References heading]

Introductory paragraph(s) go here. Paragraphs are indented a half inch from the left margin. Do not justify the right margin. Also remember to double-space your lines throughout the document. In course papers, there is no need to include an Introduction heading above these introductory paragraphs (see APA 3.03).

### **Level 1 [Centered, Bolded, Title Case]**

First paragraph(s) of section go here

### **Level 2 [Left-Aligned, Bolded, Title Case]**

Paragraphs of section go here.

**Level 3 [Tabbed .5 inches, bolded, sentence case, period].** Note that the first sentence of the paragraph in this section begins on the same line.

**Level 4 [Tabbed .5 inches, bolded, italicized, sentence case, period].** Note that the first sentence of the paragraph in this section begins on the same line.

**Main Paper Topics (Methods, Results, Conclusion, etc) are Level 1**

**Organizational Breaks Are Level 2 ("Review of Literature")**

**topics within larger organizational breaks are Level 3 (maybe separate articles?)**

**topics within level 3 breaks**

## **helpful table and figure APA style**

### **Table checklist**

- ☐ Do you mention the table in the preceding sentences to the table placement?
- ☐ Are all comparable tables presented consistently?
- ☐ Are all tables numbered with Arabic numerals in the order they are mentioned in the text? Is the table number bold and left-aligned?
- ☐ Is the title brief but explanatory? Is it presented in italicized title case and left-aligned?
- ☐ Does every column have a column heading? Are column headings centered?
- ☐ Are all abbreviations; special use of italics, parentheses, and dashes; and special symbols explained?
- ☐ Are the notes organized according to the convention of general, specific, probability?
- ☐ Are table borders correctly used (top and bottom of table, beneath column headings, above table spanners)?
- ☐ Does the table use correct line spacing (double for the table number, title, and notes; single, one and a half, or double for the body)?
- ☐ Are entries in the left column left-aligned beneath the centered stub heading? Are all other column headings and cell entries centered?
- ☐ Are confidence intervals reported for all major point estimates?
- ☐ Are all probability level values correctly identified, and are asterisks attached to the appropriate table entries? Is a probability level assigned the same number of asterisks in all the tables in the same document?
- ☐ If the table or its data are from another source, is the source properly cited? Is permission necessary to reproduce the table?

### **Figure Checklist**

- ☐ Do you mention the figure in the preceding sentences in the text?
- ☐ Is the figure simple, clean, and free of extraneous detail?
- ☐ Is the figure title descriptive of the content of the figure? Is it written in italic title case and left aligned?
- ☐ Are all elements of the figure clearly labeled?
- ☐ Are the magnitude, scale, and direction of grid elements clearly labeled?
- ☐ Are parallel figures or equally important figures prepared according to the same scale?
- ☐ Are the figures numbered consecutively with Arabic numerals? Is the figure number bold and left aligned?
- ☐ Has the figure been formatted properly? Is the font sans serif in the image portion of the figure and between sizes 8 and 14?
- ☐ Are all abbreviations and special symbols explained?
- ☐ If the figure has a legend, does it appear within or below the image? Are the legend's words written in title case?
- ☐ Are the figure notes in general, specific, and probability order? Are they double-spaced, left aligned, and in the same font as the paper?
- ☐ Has written permission for print and electronic reuse been obtained? Is proper credit given in the figure caption?
- ☐ Have all substantive modifications to photographic images been disclosed?

- ☐ Have the files been produced at a sufficiently high resolution to allow for accurate reproduction?

## **IEEE FORMATING**

**[https://owl.purdue.edu/owl/research\\_and\\_citation/ieee\\_style/ieee\\_general\\_format.html](https://owl.purdue.edu/owl/research_and_citation/ieee_style/ieee_general_format.html)**

## **INTRODUCTION**

### Guiding Questions:

1. What was the research problem?
2. What are the previous studies in this area?
3. Why was this study performed?
4. What were the aims of this study?
5. What was the hypothesis?



## INTRO/REV. OF LIT. FORMATTING

Between 3-5 pages including PGH

- o 1 inch margins and double spaced
- o Times New Roman, (size 12)
- o Page #s and Date submitted (MM/DD/YY) on bottom right and update with each draft

## Introduction

The first introductory paragraph should be a one paragraph (2-5 sentences)

It should be a BRIEF, Clear and concise summary of the topic

It should include a VERY BRIEF overview of general problem

It should also include statistics to introduce and justify the problem (cited all sources but not general knowledge)

This first paragraph is supposed to end with the basic goal of your project just to hint at what is to come

Intro paragraph is good but look at the rubric and maybe add a few more “teaser” type of sentences to really catch the interest of the reader and excite them about what they will read in the pages to come

Please read the rubric and create an opening “teaser” paragraph that quickly reviews -the Real World Issue (clear and concise mention of the issue to get attention) with cited statistics or facts

- o mention of the problem or gap in the current knowledge related to this topic
- o mention of what the goal of your project was (to get them to want to read the rest of the paper)

Vague and/or probably too lengthy for the amount of impact that it may have.

If you were “paying for words/sentences” would you still include this?

## REVIEW OF LITERATURE

Remember that the intro./rev. of lit. should be between 5-15 concise (short, clear) paragraphs

That bring the reader through a “funnel” effect from general, background information down to more specific information leading (eventually and clearly) to the problem statement(s) that YOU actually addressed.

## PROBLEM STATEMENT(S), OBJECTIVE(S), HYPOTHESIS(ES)

Remember the **problem statement** (gap) should lead to your **Objective** which will lead to your **Hypotheses** which must be justified to show your definite knowledge of this area (even if you are wrong about the hypo)

Remember.. the **Problem Statements** MUST match the **Objectives**. You should also label them to match.

It is OK to have 2-3 **Problem Statements** and then more **objectives** as it may take multiple **objectives** to match up to the few **Problem Statements**.

### INTRODUCTION, ROL, PGH Rubric

| element                                                                                                                                                                                                                   | excellent job | needs revising | missing |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|---------|
| <b>Introduction</b>                                                                                                                                                                                                       |               |                |         |
| It is clear what the general problem is (focus)                                                                                                                                                                           |               |                |         |
| It is clear why it is important to research this topic                                                                                                                                                                    |               |                |         |
| <b>Review of Literature</b>                                                                                                                                                                                               |               |                |         |
| This section is divided into subsections with subheadings                                                                                                                                                                 |               |                |         |
| There a logical flow from the first paragraph to the beginning of the literature review                                                                                                                                   |               |                |         |
| There is a logical flow to the literature review (info gained from one article leads to the next)                                                                                                                         |               |                |         |
| All concepts within the introduction/review of literature (funnel) are clearly explained and backed up with scientific knowledge and/or findings (i.e. there should be NO vague, non-scientific or non-justified phrases) |               |                |         |
| <b>Problem(s) &amp; Goal(s) &amp; Hypotheses (PGH)</b>                                                                                                                                                                    |               |                |         |
| These three subsections are clearly labeled                                                                                                                                                                               |               |                |         |
| The problem was understandable obvious after reading the introduction/review of literature                                                                                                                                |               |                |         |
| It is clear how the goal(s) address the problem(s)                                                                                                                                                                        |               |                |         |
| The justification for the hypothesis is clear                                                                                                                                                                             |               |                |         |

As a reader, can you answer the following questions:

6. What was the research problem?

7. What are the previous studies in this area?

8. Why was this study performed?

9. What were the aims of this study?

10. What was the hypothesis?

## **METHODS**

**Subheadings are your friends– they break up the complicated chain of events into understandable chunks.**

The table below roughly outlines what questions your methods should cover:

| Behavioral Study                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lab Work                                                                                                                                                                                                                                                                                                                                                                                                                         | Engineering/ Computer Science                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. How was the sampling done?</li> <li>2. How were participants grouped?</li> <li>3. What were the inclusion criteria (table 1 usually)?</li> <li>4. What were the exclusion criteria?</li> <li>5. What procedures were followed?</li> <li>6. What were the survey questions?</li> </ol>                                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. What was the experimental question?</li> <li>2. What were the experimental groups?</li> <li>3. What were controls?</li> <li>4. What tools/ materials were used?</li> </ol>                                                                                                                                                                                                             | <ol style="list-style-type: none"> <li>1. What were the goals?</li> <li>2. What was needed to accomplish them?</li> <li>3. What tests were run to see if it worked?</li> </ol>                                                                                                         |
| <p><b>For SURVEYS....</b></p> <p>You are allowed to use “I” or “Me” etc..</p> <p>You can say ... “I created the survey under the guidance of my mentor and then posted it online to maintain anonymity and as well as to stay within the guidelines of the high school Institutional Review Board (IRB)..</p> <p>highlight any consent forms you used for IRB approval</p> <p>You should add a sentence in this section that says that once the data was collected, you collated the results and</p> | <p>For any project involving humans/other vertebrate animals/cells/tissues/dangerous chemicals include:</p> <p>information about receiving training from your mentor</p> <p>approval from the Institutional Review Board (IRB) or Scientific Review Committee (SRC) or Institutional Animal Care and Use Committee (IACUC)</p> <p>the subjects used (plant, animal, human, etc.) and their pre-experiment handling and care.</p> | <p>For any project involving engineering/math/computer science include</p> <p>formulas used in explaining the experimental observations. These formulas may have been derived by others or by the authors of this paper (therefore be sure to cite the source of the information).</p> |

|                                                                                                                                           |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| then a statistician helped you to analyze the strength of the correlations between the responses in the different sections of the survey. |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------|--|--|

### **The Format of the Methodology:**

12pt Time New Roman font, double spaced

1" margins

Written in past tense

- Between 2-5 pages but it must include sufficient detail for complete replication of the experiment.

- Page #s and Date submitted (MM/DD/YY) on bottom right and update with each draft

-Logical, sequential, reproducible

-Broken up into subsections

-Outline/subheading format

-Justification for why certain steps were taken.

-Accepted methodologies are mentioned[and cite if necessary]

-Acknowledge limitations, problems, variables

### **The Focus of the Methodology:**

To clearly show the readers what you did in each step and why you did each step

- Include short justifications for the steps in the methods sections to show that you know why you did each step. Describe the experimental design clearly but do not explain standard procedures (ex. You can say "... gel electrophoresis" but you should not explain each step of that procedure)

To take the readers through the concepts and techniques that they need to know in order to understand/reproduce your study.

- This is not an exact step-by-step but more of a summary of the steps taken.

It needs to be made it VERY clear what you did (what your contribution was) vs. what your mentor/other lab members did. THIS IS ESSENTIAL!!

Role of student vs. mentor

- Clearly differentiate between work done by you, work you had assistance with (your mentor) and include the length of time that you spent on the project. This should be one to three sentences.

You would not do this in a peer-reviewed journal article, but this is a high school paper and it is required.

- o (Ex. “Over the course of \_\_\_\_ weeks, during the past \_\_\_\_ summer(s), I was responsible for ... )
- o IF you had any “tissue” (cell cultures) used in the experiment and/or live animals were the source of those tissues... Be VERY careful to differentiate that the Supervising Scientist (Mentor) did experiments on the live animal, BUT your project was ONLY a tissue/culture based project. Regeneron STS frowns on vertebrate animal research but it is 100% ok IF your mentor did their steps for them AND THEN gave you the tissues/cultures...
  - We have found out very recently that papers that did not make it clear what the exact student contributions were, did not win in competitions because the judges will likely assume your mentor really did what you are reporting and you just watched.
  - *If* you and your mentor worked on the same project and there was little distinction between what he/she did vs. you, do your best to explain what the “big picture” is that your mentor is working on (probably long after you are in the lab) and what part of that you did.

To show a VERY clear direction to your project goals and how they contribute towards addressing the “gap” or “void” in the current knowledge.

- This can include both how it is based on (or different from) the past research methodology
- Also, what worked/didn’t work for previous researchers and why you wanted to either follow their protocol or not.

- **For DATA STUDY “METADATA study”....**

- o Please make it VERY clear that this was a data based study and that these people were not recruited as a part of YOUR study. If the judge thinks that they were then that may open up a list of questions about ethics and whether or not there is an IRB and/or whether or not a student was allowed to recruit people to do this....

### **Experimental set-up/Equipment/Materials**

Provide enough quantitative detail (how much, how long, when, etc.) about your experimental protocol such that other scientists could reproduce your experiments.

Indicate the data collection procedures, units of measurement and statistical procedures used to analyze your results, including the probability level at which you determined significance (usually at 0.05 probability).

Explanation of:

- why those tests were used?
- what was the statistical significance of the results? If none, then an "industry standard" support/frame of reference must be explained
  - Look at these very good vs. not so good examples of a good way to phrase things (remember this is coming from scientist researchers that could very well be research paper competition judges:
    - Very good #1 – “The transformed E. coli strains were cultured in 37 degrees Celsius in Luria Broth supplemented with Kanamycin, in order to allow them to...”
    - Very good #2 – The double stranded plasmid was isolated using a Miniprep kit following the manufacturer's instructions (Qiagen, City, State).
- Both of the above are clear, concise and able to be reproduced in a lab somewhere
  - Not so good #1 - The correlation between the dosage and the blood pressure rate was confirmed.
- PROBLEMS: Not good because: What does “correlation mean”? Direct or Inverse relationship? What is the dosage? What is the range of the dosage? What is the normal range of dosage vs. blood pressure? What is the typical blood pressure for someone taking any dosage of this? I could keep going on...
  - Not so good #2 – By raising the concentration of the chemicals in the water, we could determine the effect on the growth rate.
- PROBLEMS: Concentration of what? What is a typical concentration? What other chemicals are in the water? Nitrates? Phosphates? Salt? What concentrations of those? What types of animal? What size of animal? What age of animal? What is a typical growth rate of this animal? What else could be the cause of a growth rate change? Did all of the animals in the test group grow at the same rate?

Specific reference to how the results of this study were similar or different to others.

Cite references

Brief but clear statements of what was found

- At least one visual/chart/graph/image to support each statement
- charts have descriptive title, both axes are labeled, units are present, only three horizontal lines,
- captions explain importance of chart/graph/image

How did this improve upon other studies? Cite references

## **What to include and/or avoid**

You should include FIGURES (pictures (labeled/credited) and graphics) to help explain, wherever possible. Label with a title and a very brief explanation “Figure 1. The XYZ setup used to ...”. If you took the picture then cite it as “photo by your name”. If you got the pictures/graphics/charts online or from other researchers then cite them appropriately under the picture.

**Never put an abbreviation in a paper without first writing out what it stands for, (and putting the abbreviation in parenthesis)**

**You can use a flowchart (but to help the reader understand the progression of the steps. If you use this then you would label insert it as you would a picture or graphic (ex. “see figure 1”)**

The experimental OR sampling design (i.e., how the experiment or study was structured. For example, controls, treatments, the variable(s) measured, how many samples were collected, replication, etc.)

The source for reagents used parenthetically, e.g., "...poly-l-Lysine (Sigma #1309)."

Always identify treatments by the variable or treatment name, NOT by an ambiguous, generic name or number (e.g., use "2.5% saline" rather than "test 1".)

For any project involving nature/environmental/engineering/animal behavior research include:

a description of the study site, the physical and biological features, and precise location when and for how long, the study was done  
information about receiving training from your mentor

Support that the hypotheses that was tested, controls, treatments, variables measured, how many times the experiment was replicated, what was actually measured, what form the data take, etc.

Review of whether the goals were/weren't accomplished?

Can the reader answer the following questions:

7. How did the researcher attempt to answer the question?
8. How was the sampling done?
9. How were they grouped?
10. What were the inclusion criteria (table 1 usually)?
11. What were the exclusion criteria?
12. What procedures were followed?



13. Which variables were measured?
14. What equipment was used?
15. What statistical methods were used?

|                                                                                                                                                                                                                                                                    |                  |                       |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------|----------------|
| <b>Methods Section NON Survey</b>                                                                                                                                                                                                                                  |                  |                       |                |
| <b>element</b>                                                                                                                                                                                                                                                     | <b>excellent</b> | <b>needs revising</b> | <b>missing</b> |
| <b>Opening Paragraph</b>                                                                                                                                                                                                                                           |                  |                       |                |
| <p><b>This is a paragraph or two that summarizes the methods.</b></p> <p><b>This is basically a review of how the Goals were addressed.</b></p>                                                                                                                    |                  |                       |                |
| <b>Actual Methods</b>                                                                                                                                                                                                                                              |                  |                       |                |
| <p><b>If the methods ARE divided into subsections, how DO these help to make the methods more understandable?</b></p> <p><b>OR</b></p> <p><b>If the methods are NOT divided into subsections, how WOULD this help to make the methods more understandable?</b></p> |                  |                       |                |
| <p><b>There is a brief but clear explanation of the role of the supervising scientist (mentor)</b></p> <p><b>vs. the role of the student researcher</b></p>                                                                                                        |                  |                       |                |

|                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <p><b>There is a logical, sequential, “flow” to the methods so that the reader understands the goal of each part and how one part led to the next (but not an exact step-by-step description).</b></p> <p><b>Ex) “A 2.5mg/kg concentration of Mg(OH)<sub>2</sub> was used in order to...”</b></p> <p><b>It doesn’t say how they made that concentration</b></p> |  |  |  |
| <p><b>There is a clear justification as to why the different steps were done and why certain materials were used</b></p>                                                                                                                                                                                                                                        |  |  |  |
| <p><b>There is a clear explanation of the potential problems or limitations of the project including but not limited to; confounding variables &amp; confusing results</b></p>                                                                                                                                                                                  |  |  |  |
| <p><b>There are enough graphics and/or pictures, with captions to visually help explain the different steps</b></p>                                                                                                                                                                                                                                             |  |  |  |

|                                                                                                                                                                                                                                                                                 |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <p><b>If the methods section was SHORTER than 3 pages, what should have been added?</b></p> <p><b>If the methods was between 3-6 pages, what parts seemed too long or too short</b></p> <p><b>If the methods section was LONGER than 6 pages what should have been cut?</b></p> |  |  |  |
| <p style="text-align: center;"><b>Methods Section for survey based research</b></p>                                                                                                                                                                                             |  |  |  |
| <p><b>Opening paragraph(s)</b></p>                                                                                                                                                                                                                                              |  |  |  |
| <p><b>This is a paragraph or two that summarizes the methods.</b></p> <p><b>This is basically a review of how the Goals were addressed.</b></p>                                                                                                                                 |  |  |  |
| <p><b>Actual Methods</b></p>                                                                                                                                                                                                                                                    |  |  |  |
| <p><b>If the methods ARE divided into subsections, how DO these help to make the methods more understandable?</b></p> <p><b>OR</b></p> <p><b>If the methods are NOT divided into subsections, how WOULD this help to</b></p>                                                    |  |  |  |

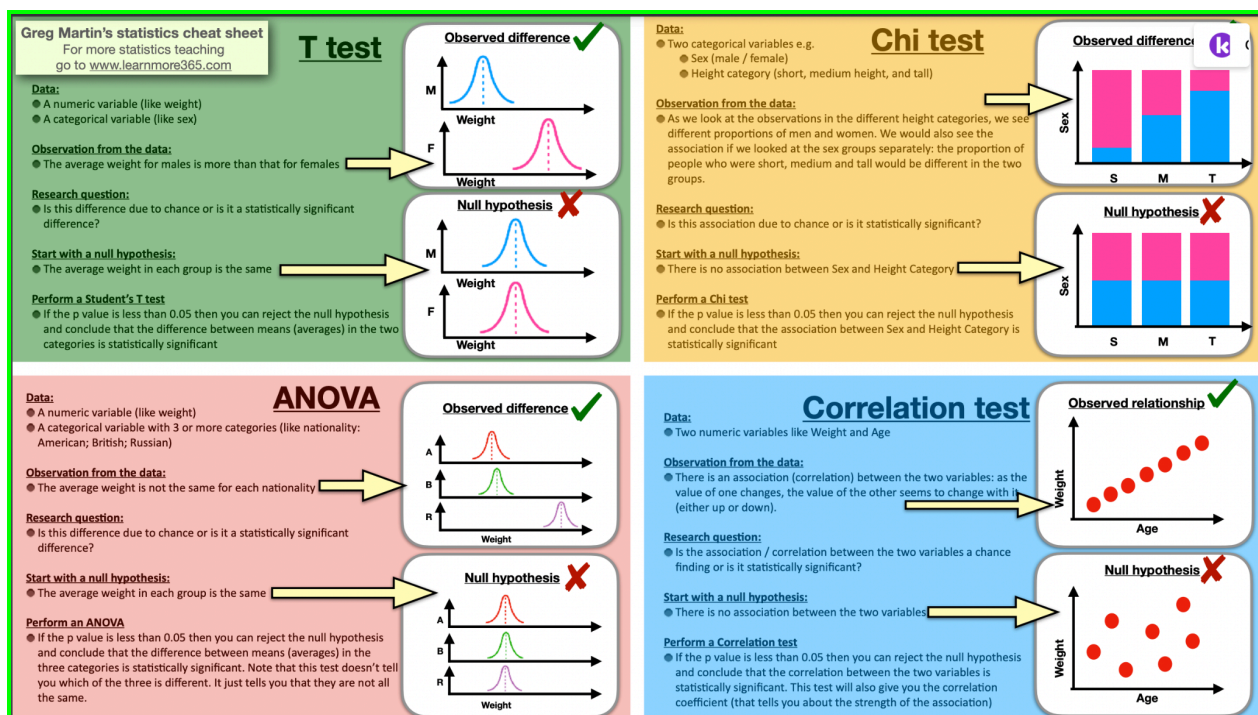
|                                                                                                                                                                                                                |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <b>make the methods more understandable?</b>                                                                                                                                                                   |  |  |  |
| <b>There is a brief but clear explanation of the method of survey distribution</b>                                                                                                                             |  |  |  |
| <b>There is a logical, sequential, “flow” to the methods including enough sample survey questions so that the reader understands the goal of each part and how one section of the survey leads to the next</b> |  |  |  |
| <b>There is a clear justification as to why the different sections of the survey were included</b>                                                                                                             |  |  |  |
| <b>There is a clear explanation of the potential problems or limitations of the project including but not limited to; why certain groups were included, why some groups should have been but weren't</b>       |  |  |  |

|                                                                                                                                                                                                                                                                                |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <p><b>If the methods section was SHORTER than 3 pages, what should have been added?</b></p> <p><b>If the methods was between 3-6 pages, what parts seemed to long or too short</b></p> <p><b>If the methods section was LONGER than 6 pages what should have been cut?</b></p> |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|

## **RESULTS & DISCUSSION**

- Now that you have what happened (the data), you need to decide if it matters.
- Statistical analysis, interpretation and comparison to past work all can go in this section
- Include tables AND FIGURES (line graphs, bar graphs)
- Make sure the captions are single spaced and connected physically to the graphic and that they explain the basics and are not just a copy of the title. The reader should be able to understand and appreciate the info in this table or figure just by reading the caption.
- Captions help to explain the images
- - Caption must be in text box that does not extend beyond the graphic (APA format) or beyond the one inch margins
- - Titles & captions are on same page as picture/graph
- - TABLES are always titled ABOVE the table. They are referenced in-text before the table appears in a relevant sentence:
- Relevant sentence like this: (see Table 2). Or, “As seen in Table 2, BMI increased an average of 14% over time...”
- **- Tables have descriptive title, both axes are labeled, units are present, only three horizontal lines (Above the headings, below the headings, on the bottom of the table) with NO vertical lines.**
- **Tables should have only 3 horizontal lines as is seen in most journal articles. A line on the top of the column headings, a line below the column headings and a line at the very bottom. Please remove all other horizontal and all vertical lines. We want this to look like a journal article**

- FIGURES are captioned BELOW and referenced in-text before the figure appears, at the end of the relevant sentence like this: (see Figure 2). Or, “Figure 2 shows the correlation of...
- \*\* Also.. be SURE to refer to them in the text of the Results (or Discussion)
- You need a data table to show the results of this part.
- You need to include actual statistical analysis ( $p < .05$ ) or ( $p > .05$ ). Perhaps your mentor can help you with this. If they cannot help you in the next day or so, maybe you can do it on your own. Try to do this with a TI calculator or online. You are basically trying to run a “Student T-Test” to compare the averages of the two different groups.
- If you have 4 (quadrant) variables ex. Plants in sun with water, Plants in sun without water, Plants in shade with water, Plants in shade without water... then you would run a X2 (Chi-square)



- Don't use the word “significant” unless you are talking about statistically significant.** If you are then you must list a supporting number or a refuting number
- Ex. “There was a statistically significant difference between... and ..... ( $P < .05$ )” Or The results did not show a statistically significant .... ( $p = .23$ )

- Also be sure to use terms like “.... In order to...”, “.... So that....”

**Choose a different word than “Prove”**

- Science fair readers/judges will take strong objecting to any student that uses the word “prove” anywhere.

- We never “prove” anything in science. We may support (even statistically) a hypothesis or refute it but don’t prove anything.
- At least one figure (chart/graph/image) or table to support each statement
- BUT.... The results MUST be clear and concise and MUST be Free from any and all interpretation (absolutely no opinions)

**This is how data should be displayed as a table in your paper and on the poster. Notice the (primarily) 3 horizontal lines with no vertical lines**

Table 2. Ratio of journal papers of EUJ and CEE countries by field in two different periods

| Field         | CEE       | EUJ       | 100 CEE | CEE       | EUJ       | 100 CEE |
|---------------|-----------|-----------|---------|-----------|-----------|---------|
|               | 1981–1985 | 1981–1985 | EUJ     | 1995–2005 | 1995–2005 | EUJ     |
| Life sciences | 35.20     | 57.84     | 60.9    | 38.28     | 56.87     | 67.3    |
| Chemistry     | 24.27     | 12.96     | 187.3   | 20.11     | 11.29     | 178.1   |
| Physics       | 23.67     | 17.24     | 137.3   | 17.32     | 13.85     | 125.1   |
| Engineering   | 12.77     | 9.05      | 141.1   | 19.76     | 15.43     | 128.1   |
| Mathematics   | 4.07      | 2.89      | 140.8   | 4.52      | 2.56      | 176.6   |

Legends:

CEE: Central and Eastern European countries

EUJ: 14 European Community Member States, the US, and Japan

1981–1995: The data are derived from [SCHUBERT & AL., 1989]

1995–2005: The data are derived from ISI Essential Science Indicators, Thomson Scientific

- **For SURVEYS....**
  - List these in this way  
“statistical statement and then ( $r = ???...$ ,  $p < .05$ )”
- You would put in the  $r$  value where the  $???$  is and you can report the  $P$  value as  $p < .05$  which is statistically significant or (even better)  $p < .01$  IF the  $P$  value is indeed less than .01

The following tables are examples of how to show data from a correlation matrix (with correlation “r” values) as a table in your paper and on the poster. This is most commonly used in behavioral research papers.

**Table 2.** Correlation Between Coded Variables at the Effect Size Level

|                                       | 1      | 2      | 3     | 4    | 5     | 6     | 7     | 8     | 9     | 10     | 11    | 12     | 13    |
|---------------------------------------|--------|--------|-------|------|-------|-------|-------|-------|-------|--------|-------|--------|-------|
| 1. Transformational leadership mean   |        |        |       |      |       |       |       |       |       |        |       |        |       |
| 2. Self-report                        | -.03   |        |       |      |       |       |       |       |       |        |       |        |       |
| 3. Army, police, and security         | .13    | -.39** |       |      |       |       |       |       |       |        |       |        |       |
| 4. Health service                     | .18    | .07    | -.11  |      |       |       |       |       |       |        |       |        |       |
| 5. Part-time students                 | .27*   | .09    | -.15  | -.11 |       |       |       |       |       |        |       |        |       |
| 6. Private sector (vs. mixed)         | -.35** | .13    | -.21  | -.15 | -.21  |       |       |       |       |        |       |        |       |
| 7. Public sector (vs. mixed)          | -.04   | -.24   | .69** | .17  | -.22  | -.30* |       |       |       |        |       |        |       |
| 8. Harmony (vs. mastery)              | -.40** | .13    | -.32* | -.09 | -.29* | .14   | .07   |       |       |        |       |        |       |
| 9. Egalitarianism (vs. hierarchy)     | .16    | -.00   | -.17  | -.18 | -.11  | -.03  | -.09  | .63** |       |        |       |        |       |
| 10. Autonomy (vs. embeddedness)       | .17    | .05    | -.17  | -.23 | -.16  | -.03  | -.07  | .57** | .82** |        |       |        |       |
| 11. Masculinity                       | .06    | -.08   | -.09  | -.07 | .26*  | .02   | .02   | -.07  | -.13  | -.01   |       |        |       |
| 12. Power distance                    | -.52** | .04    | .26*  | .17  | -.06  | .22   | -.26* | .31*  | -.25* | -.43** | -.09  |        |       |
| 13. Individualism-collectivism        | .32*   | -.18   | -.10  | -.17 | .36** | .11   | -.06  | -.19  | .33** | .39**  | .41** | -.52** |       |
| 14. Wealth (GDP per capita 1985-2005) | .30*   | -.18   | .02   | .01  | .41** | -.14  | -.03  | -.19  | .26*  | .15    | .21   | -.37** | .80** |

Note: GDP = gross domestic product.

\* $p < .05$ . \*\* $p < .01$ .

## CONCLUSION & APPLICATIONS

- Clear, concise review of the following areas:
  1. Objectives
  2. Methods
  3. Findings (results)
  4. Analysis of relevance and importance (discussion)
  5. Contains a powerful, impact statement
- Review of objectives and hypotheses
- Was the objective(s) accomplished?
- Was the hypothesis(es) supported or refuted?
- The conclusion needs to more clearly state what was actually concluded. Did you succeed in all objectives?
- If YES then say so. Return to the hypotheses and address them specifically.
- THE READER MUST NEVER HAVE TO WORK OR STRUGGLE IN THIS PART OF THE PAPER.
- It needs to flow clearly and simply like this – we specifically addressed “X”, the result was “Y”, this means “Z” and now for the first time we can better....”ABC”
- If something is novel/new/cutting edge then say so as long as your mentor is ok with it



- Remember that this is the Application section which is basically the “ok, so what would you do with your insight if you had money and time” section and not just a reminder of what was in the results
- End on a big idea, something provocative and NOVEL

## ● **FUTURE RESEARCH**

- You should talk about what was still not known.
- What new questions/gap in knowledge did your research uncover that now must be addressed in the next phase.
- Don't forget to make it clear what exciting new findings the next phase of research may uncover.

## ● **WORKS CITED**

- In keeping with APA format...
- -Remove the numbers
- -Alphabetize the citations
- -Reverse “Hanging” indentation where the 2<sup>nd</sup> and 3<sup>rd</sup> line are indented
- (Go to “Paragraph” settings then “indentation” then “special” there is one called “hanging indent”
- Tier 1 heading and should be centered.
- Then the subsections (if there are any) would be tier 2 and would be bolded, left justified and on a line by themselves.
- All lines should be double spaced with the 1<sup>st</sup> line left justified and then the rest of the lines of each citations indented. (called “hanging indent”)
- Also.. Since we are doing this in parenthetical format (Homer, 2000) then the works cited should be in alphabetical order without the numbers in front of each
- 

Can a reader answer:

1. What were the conclusions?
2. Were the authors' conclusions based upon reported data and analysis?
3. Were the conclusions reasonable and logical?
4. Will the results be useful in clinical practice/ further research?
5. Was the study worth doing?
6. What are the unanswered questions?

| Results, Discussion, Future, Conclusion Sections                                                                                                                                                                                                          |               |                |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|---------|
| element                                                                                                                                                                                                                                                   | excellent job | needs revising | missing |
| <p><b>There a full and clear explanation of QUANTITATIVE (numerical) results.</b></p> <p><i>Assess whether charts are labeled with descriptive titles, brief explanatory captions, units, and possible range of values.</i></p>                           |               |                |         |
| <p><b>There is a full and clear explanation of QUALITATIVE (observational) results.</b></p> <p><i>Assess whether there are pictures labeled with descriptive titles, brief explanatory captions, magnifications and/or relative sizes with units.</i></p> |               |                |         |
| <p><b>There is a clear explanation of the statistical analysis of the data.</b></p> <p><i>Does he/she include why the specific types of statistical tests were used (or was this addressed in methodology)?</i></p>                                       |               |                |         |
| <p><b>There is a reference to how the results relate to previous research.</b></p> <p><i>Were they clearly explained? Was the previous research cited</i></p>                                                                                             |               |                |         |
| <p><b>There is a clear explanation of whether the hypotheses were supported or refuted.</b></p>                                                                                                                                                           |               |                |         |
| <p><b>Future areas of research are clearly described.</b></p> <p><i>Are these experiments clearly described with specific tests, or are they vague and lacking sufficient detail to know what should be done next?</i></p>                                |               |                |         |
| Conclusion Section                                                                                                                                                                                                                                        |               |                |         |

|                                                                                                                                                                                |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <p><b>There is a brief review (summary)</b></p> <p><i>Does it include a review of the Goals, Methods, Findings (results) and Analysis (discussion)?</i></p>                    |  |  |  |
| <p><b>Ease of understanding</b></p> <p>A reader can skim this part and still understand it- there is nothing new or jolting</p>                                                |  |  |  |
| <p><b>Further research</b></p> <p>The next gap in the research is explained</p> <p>A provocative/ important idea that might push the science forward even more is included</p> |  |  |  |

Science Scholar's Sample Paper Title

Talia Dardis

Edgemont High School

## Abstract

### **Science Scholars Sample Paper**

Talia Dardis

Body of abstract, in fully sentences:

- What you did, how you did it, what it means, why you did it and what you found.
- Citing of experimentation completed by submission date.  
(Anticipated experimentation or results should not be included.)
- Diagrams, if used, must be drawn in black ink.
- Reference to a specific procedure should be restricted to a description of the process employed.
- State results, conclusions or findings clearly and concisely.
- Credit any financial sponsorship at the end of the abstract: “Research supported by...”

## SCIENCE SCHOLARS SAMPLE PAPER

2

Start your paper here- this will be where your introduction will go. It does not get a labeled header.

Style: Make it catchy, interesting and filled with facts. You are selling your topic and YOURSELF as an expert.

Citations: Make sure to cite all facts/ stats/ ideas using APA format: (Last Name, year), or, “According to Last name (year), “blah blah blah.” These sources will be listed, using APA style, in your works cited page at the end of the paper.

Tables can be included. [See this section for more details on tables and figures.](#)

This is how they should look (no horizontal lines, with a title and a caption

## Tables and Figures

### Tables

The diagram illustrates the components of a prototypical APA table. The table is titled "Table 1" and "Numbers of Children With and Without Proof of Parental Citizenship". It is organized into two waves (Wave 1 and Wave 2) and further divided by gender (Girls and Boys) and proof status (With and Without). The table includes a total row for each wave. Annotations point to various parts of the table, including the table number, title, stub heading, table spanner, column spanner, decked heads, column heading, cell, table body, stub column or stub, and table notes.

| Grade  | Girls            |                  | Boys             |         |
|--------|------------------|------------------|------------------|---------|
|        | With             | Without          | With             | Without |
| Wave 1 |                  |                  |                  |         |
| 3      | 280 <sup>a</sup> | 240 <sup>b</sup> | 281              | 232     |
| 4      | 297              | 251              | 290              | 264     |
| 5      | 301              | 260              | 306              | 221     |
| Total  | 878              | 751              | 877              | 717     |
| Wave 2 |                  |                  |                  |         |
| 3      | 201              | 189              | 210              | 199     |
| 4      | 214              | 194              | 236              | 210     |
| 5      | 221              | 216              | 239              | 213     |
| Total  | 636              | 599              | 685 <sup>a</sup> | 622     |

**Table notes:** explanations to supplement or clarify information in the table body

*Note.* This table demonstrates the elements of a prototypical table. A general note to a table appears first and contains information needed to understand the table, including definitions of abbreviations (see Sections 7.14–7.15) and the copyright attribution for a reprinted or adapted table (see Section 7.7).

<https://apastyle.apa.org/style-grammar-guidelines/tables-figures/tables>

### APA table format

- Table number in bold above the table.
- Brief title, in italics and title case, below the table number.
- No vertical lines.
- Horizontal lines only where necessary for clarity.
- Clear, concise labels for column and row headings.
- Numbers consistently formatted (e.g. with the same number of decimal places).

**This is how data should be displayed as a table in your paper and on the poster. Notice the (primarily) 3 horizontal lines with no vertical lines**

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| Field         | CEE       | EUJ       | 100 CEE | CEE       | EUJ       | 100 CEE |
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Legends:

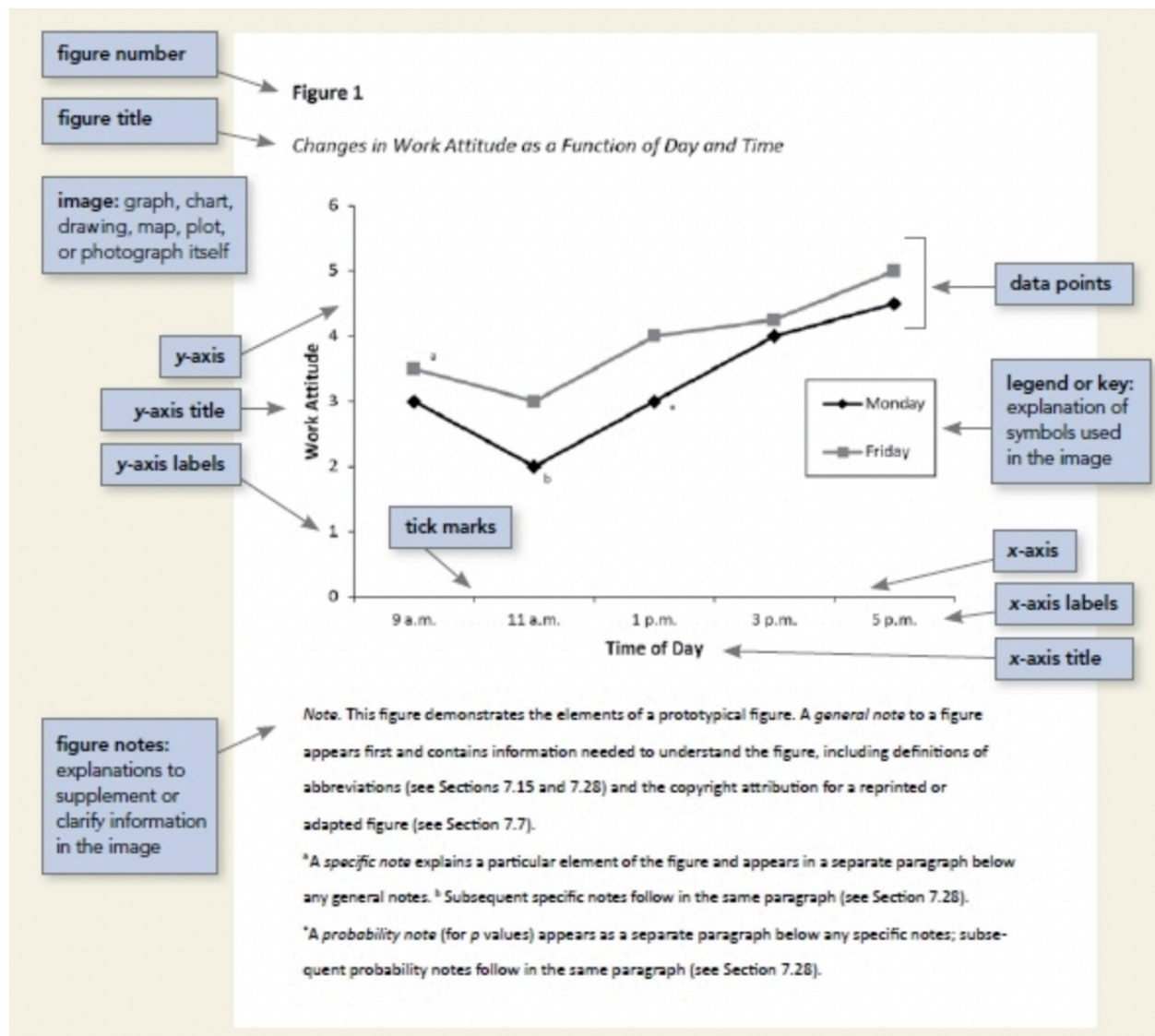
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EUJ: 14 European Community Member States, the US, and Japan

1981–1995: The data are derived from [SCHUBERT & AL., 1989]

1995–2005: The data are derived from ISI Essential Science Indicators, Thomson Scientific

Figures



<https://apastyle.apa.org/style-grammar-guidelines/tables-figures/figures>

### APA Figure format

- images are clear
- lines are smooth and sharp
- font is legible and simple
- units of measurement are provided
- axes are clearly labeled
- elements within the figure are clearly labeled or explained