Science Writing & Research Posters

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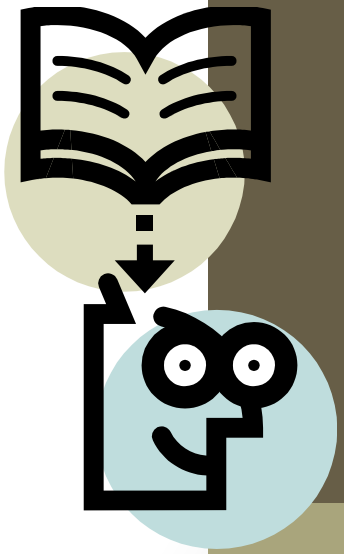
Science & Communication

- **Communication skills are a critical component of the scientific process.**
  - A scientist must be able to communicate the ideas and the result of their work in order for other scientists to build on their work and make further discoveries.
  - Without communication, science cannot advance or progress.

- **When they complete their work, scientists must apply to publish their research in a peer-reviewed scientific journal.**
  - Peer Review Journal: an academic publication that only publishes submissions after a review and full approval by a panel of other people in the same field who review the paper for accuracy.
  - When they receive a submission, a journal will send their work to a panel of 2-3 scientists doing work in the same field.
  - The panel will review the submission and determine if the work is accurate, credible, original, thorough, logical, etc.

Peer Review

- **Peer review elevates the quality of science writing by…**
  - Detecting weaknesses & errors in papers or methods before publishing (if they exist)
  - Rewarding high quality work while discouraging inferior work (by not publishing it)
  - Offering a fair, unbiased assessment of the quality of research (through the use of independent and usually anonymous review)
  - Reducing the likelihood of fraud, plagiarism, and lying.



- **Peer review does have some disadvantages including…**
  - It is slow – it can take weeks, months, or even years for approval
  - There may be bias against highly original works or breaking methods (especially if they contradict widely-held notions)
  - At times, fraud can be missed by peer review panels
  - However, peer review is still the best method available for establishing credibility.

- **The Internet has improved peer review by lessening the review time and increasing the likelihood that fraud will be caught.**

Journals & Credibility

- **Peer reviewed journals only print articles that are deemed accurate and credible by people who are in a position to make that determination.**
  - This is why research journals tend to be among the most credible sources of information in science.
  - For an article to be published, multiple people in a field must agree to its legitimacy. If in doubt, the article is not accepted or published.

- **If a scientist is not skilled in written communication, their work will not be published and they may not have a job!**
  - Publish or perish!

- **Scientists can also directly present their work at a symposium.**
  - A symposium is an event where many scientists present their work in person on a particular subject using posters, papers, or essays.
  - Usually a scientist must be on hand at a symposium to present their work orally and in writing.

Science Writing

- **No matter how a scientist is presenting their work, the style of science writing is usually similar.**
  - Scientists follow a very rigid style of writing so that all publications are consistent and predictable.
  - If you need to review a lot of material quickly for specific pieces of information, it is very helpful to know where those specific facts will be located. Articles that do not follow this style are disregarded.

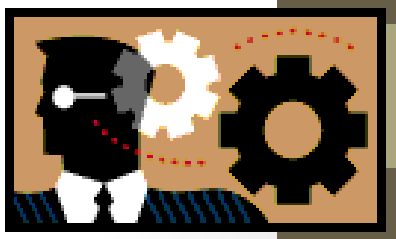
- **Science writing should include the following in this order:**
  1. Title & Authors
  2. Abstract (summary)
  3. Introduction & Background Information
  4. Methods & Materials
  5. Results (w/ graphs and/or tables)
  6. Discussion & Conclusion
  7. Bibliography/Works Cited

Title & Authors

- **Titles in science writing tend to following a very specific pattern.**
  - This is the first thing a reader will see
  - A title must convey all important aspects of an experiment so that the reader can gauge if it is worth reading the entire thing.

- **A title should include the following:**
  1. Study subject: what the researchers were testing
  2. Independent variable: what the researchers were changing
  3. Dependent variable: what the researchers where measuring
  4. Outcome: what happened in their experiment?

- **Titles should not be flashy or exciting; instead they should convey a lot of information in a short sentence.**
  - You are NOT trying to entertain but to inform!

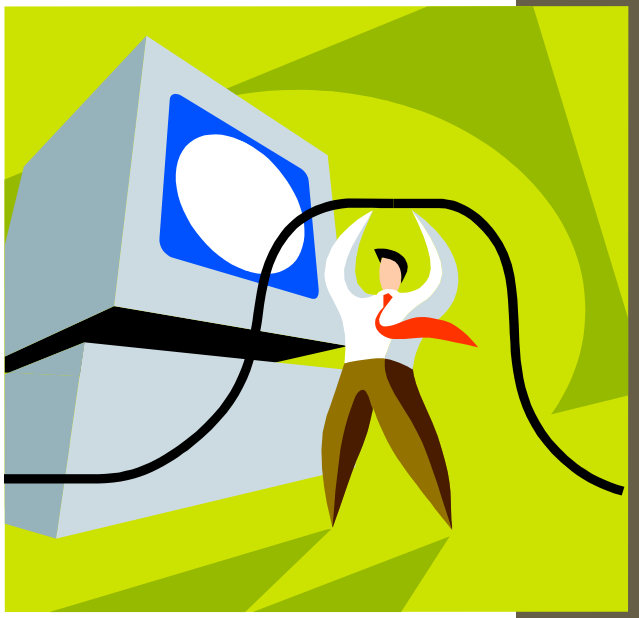


Examples of good titles

- *"Addition of Gatorade to Radish Plants Did Not Increase the Average Height of the Seedlings Compared to Control"*
- *"9th Grade Students Who Consumed 50 Mg Of Caffeine Prior To Testing Scored 12% Higher On Standardized Test Compared To Control."*
- *"Addition Of Protein Supplement To Feeder Pig Diet Did Not Significantly Increase The Average Weight Of Pigs Compared To The Control"*
- Be sure to also include a) the **authors** (in alphabetical order of last name), **place of publication,** and **date.**
  - E.g. "*Badger, Bucky. Wolverine, Wally. Waterford Union High School. September 2012.*"

Abstract

- **An abstract is a summary of the entire research publication.**
  - It is meant to convey all of the key points as quickly and shortly as possible.
  - An abstract should be less than 250 words.

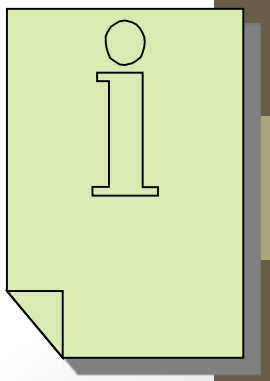


- **An abstract should consist of:**
  1. A brief sentence with facts about your study subject from your background information.
  2. Your hypothesis and rationale.
  3. A quick summary of your methods.
  4. The results (or expected results)
  5. Conclusions and implications of your work.

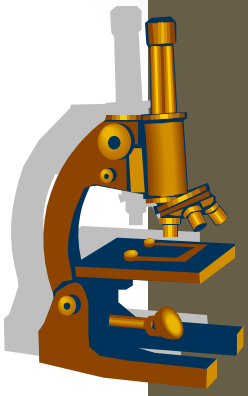
- **An abstract is not always necessary – check to make sure it is needed before starting an assignment or presentation.**
  - It is often a good idea to finish your abstract last after all other writing is finished – you can pull and rephrase from work you've already done.

Introduction

- **The Introduction consists of the following in this order…**
  1. **Background Information**: these are the concepts, facts, and terminology from other sources related to your experiment.
     1. This is the information necessary for the average reader with no background in the field to understand your work.
     2. All facts should be followed with parenthetical citation.
     3. All sources should be cited parenthetically (Last Name, Year), and in your bibliography (Last Name, First Name. Year. Title. Website).
  2. **Research Question**: what were you trying to figure out (We were unsure if….)
  3. **Hypothesis**: what you thought would happen (We predicted that…)
     1. A hypothesis must be measurable!!! "Better" is not measurable!
  4. **Rationale**: why you thought your hypothesis was right
  5. **Summary of Methods**: an overview of how an experiment was done ("To test this, we….")



Methods & Materials



- **The methods section of a science publication is necessary to show that your work was credible and that the results are meaningful.**
  - The reader may also wish to replicate your work for their own experiments or to determine if your results are consistent.
  - The Methods section is usually one of the MOST scrutinized sections of science writing – most of the legitimacy of an experiment comes from how it was conducted.
    - Most of the flaws are found here too!

- **For these reasons, the methods section must be detailed and thorough.**
  - It should resemble a cookbook recipe – NO details can be left out!
  - <u>It should be detailed enough that anyone anywhere could replicate your work and get the exact same results without ever talking to you</u>

Examples of a Methods Section

Poor example:

We grew radishes and then added Gatorade to see if they would grow better. We checked them two weeks later.

Better example:

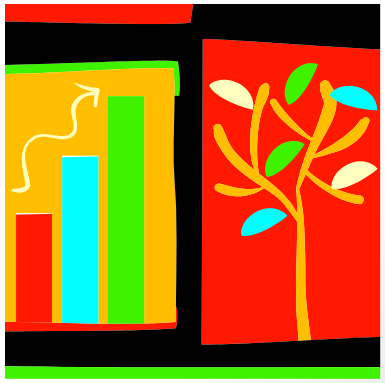
- ***Materials****: Menards-brand topsoil; standard greenhouse six-pack trays, radish seeds, tap water, Orange-flavored Gatorade, metric ruler.*
- ***Methods****: Using a standard greenhouse six pack tray, we added Menards store-brand topsoil to each tray so that it was flush with the top of the tray. We made ½ inch indentations with our pinky finger into the soil of each compartment and added one radish seed per hole. We covered the hole with soil and moistened the soil with tap water. We then added 5 ml of Gatorade to each compartment. An untreated control was also made using the same methods. The trays of radishes were watered with 100 ml of water per day. After two weeks, we measured the height of the radishes in centimeters from the base where the seedling emerged to the highest point of the radish plant (after it was gently stretched).*

Results

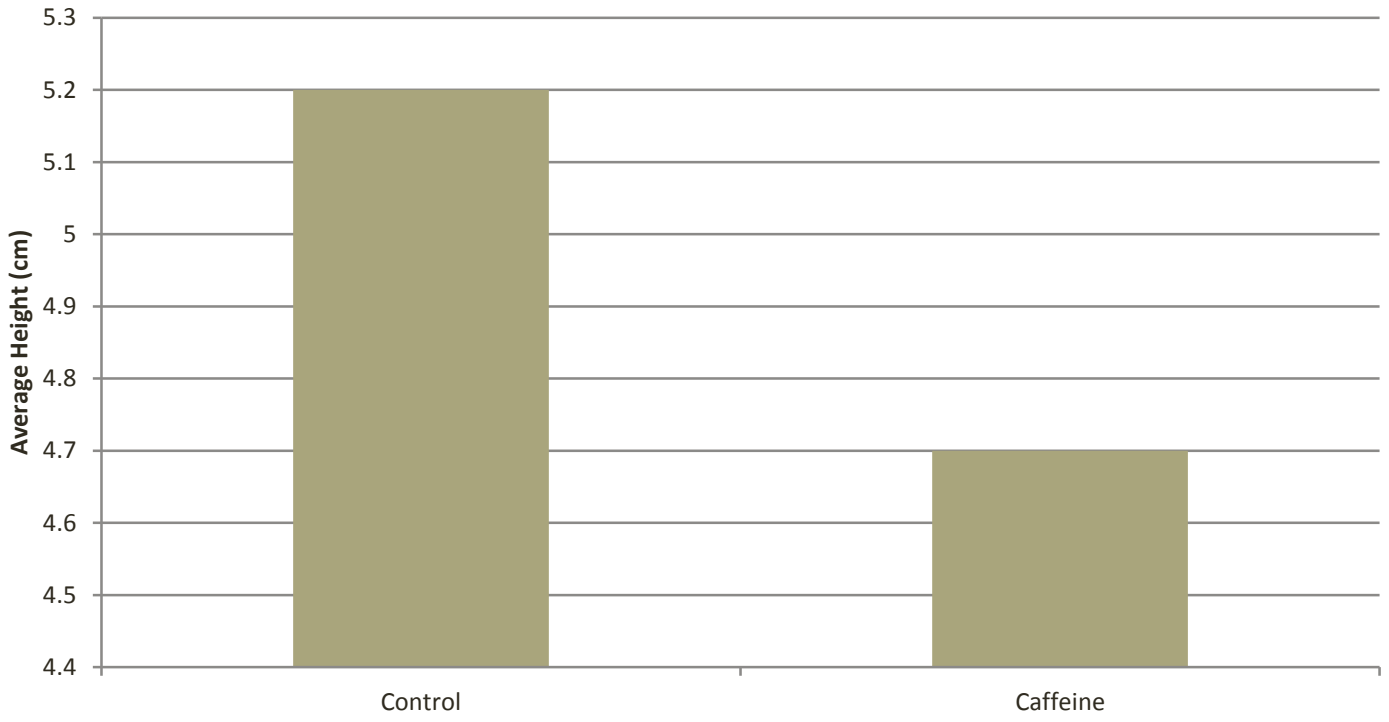
- **The Results section provides all relevant data and observations from your experiment.**
  - It does NOT provide an explanation of what these results mean – this part comes at the end in the Discussion & Conclusion.

- **Your Results section should also include *at least* one graph or table summarizing your data.**
  - A graph or table does not need a title but it MUST have a caption.
  - A caption should describe what the graph is showing and what that means.
  - All axes must be identified and labels or a legend must be provided.

- **Your results section should also include the observations of the researchers – i.e. what are some things that you saw as a group that wouldn't be reflected by the data.**
  - For example, if you noticed that all of the treated radishes turned orange, the average height alone would not reflect this and it should be mentioned separately.



Example graph



As you can see in this graph, the radishes treated with Gatorade were 0.5 cm shorter on average than the plants in the control group.

Results

- **Be as detailed about your results as you possibly can.**
  - For example, do not say “some plants wilted”.
    - Instead, say “17 of the 34 plants wilted”.
  - Do not leave the reader to guess what happened so far in your experiment – be as specific and detailed as you can.

- **Provide all the information that you can, both statistical and anecdotal, to the reader.**
  - NEVER leave out anything that might be relevant to the conclusion of whether the hypothesis was right or wrong!
  - Anything that you think might be relevant should be included.

Discussion & Conclusion

- **A Discussion & Conclusion section summarizes the meaning of your data as it relates to your original question and hypothesis.**
- *Your Discussion and Conclusion should include the following:*

1. First restate your hypothesis (We hypothesized that…)
2. Next, explain how this experiment affects your hypothesis
   - *i.e. how does your data support/reject/not impact your hypothesis?*
3. Third, describe why you think the data supports/refutes/does not affect your hypothesis
   - *What data or general trends have you considered that have led you to make this conclusion.*
4. Fourth, describe if you think your results are consistent or if there is a possibility that the results could be different if the experiment were run again or if it were done by other people.
5. Follow up with a discussion about the relevance of your experiment – who will this help?
   - *Why is this work beneficial? What is the value of this experiment and why was it necessary?*

Bibliography/Works Cited

- **A bibliography is the summary of all the sources you used to create your paper.**
  - All sources used for this experiment must be cited using APA citation.
  - FOR WRITTEN SOURCE: Last Name, First Name. (Year). Title of Document. Publisher. City.
  - FOR WEBSITE: Last Name, First Name. (Year & Date). Title of Website. Retrieved from *(website)*.
    - E.g. *Badger, Bucky. (Sept. 2012). Supremacy of Wisconsin Football. Retrieved from www.wisc.edu*
  - Only use credible websites that end in .gov or .edu (or, sometimes, .org)

- **All sources should be listed alphabetically by author's last name (e.g. Anderson before Baker).**
  - If there are more than 3 authors, list the first author's name followed by "*et. al.*"
    - This means that there were too many authors to list them all; *et. al.* means "and others" in Latin. E.g. Baker, John *et. al.*
  - In some cases, a specific author may not be listed for a website. If this is the case, use the institution that published the website
    - E.g. Dept. of Horticulture, UW-Madison (Sept 2012). Gardening Practices. Retrieved from www.wisc.edu/hort/docs

- Badger, Bucky. Wolverine, Wally. (Oct, 2011). “Gatorade Consumption Improves Average Pushup Performance of Big Ten Mascots.” UW Athletic Department, www.mascots.wisc.edu

Addition of Gatorade to Radish Plants Did Not Increase the Average Height of the Seedlings Compared to Control

Badger, Bucky. Wolverine, Wally. Sept, 2012. Agricultural Sciences, Waterford WI.

ABSTRACT: To absorb water, plants must use sodium and potassium in their roots (UW Hort, 2012). We predicted that radishes treated with Gatorade would be taller on average than a control given tap water. We thought this would be the case because Gatorade could provide more of the sodium and potassium needed for plant roots to absorb water. We grew two sets of radishes, one treated with Gatorade and the other treated with tap water and measured their average height after two weeks of growth. After two weeks, we found that the radishes treated with Gatorade were 0.5 cm shorter on average than the control. While this demonstrates that Gatorade probably does not aid plant growth, this may change if it were directly injected into the plant.

Introduction: Background Information: all plants use sodium and potassium to aid the absorption of water from the soil (Baker, et.al. 2010). Sodium and potassium attract water, and water will go from areas that are low in these ions (such as the soil) to areas that are higher in these elements, such as the roots of plants (UW Dept of Horticulture, 2009). Gatorade was a drink designed to raise levels of sodium and potassium in athletes (Univ. of Florida, 1965). Research Question: We wondered if adding Gatorade to radishes would increase the average height of radish seedlings. Hypothesis: We predicted that radishes treated with Gatorade would be taller on average than a control given tap water. Rationale: We thought this would be the case because Gatorade could provide more of the sodium and potassium needed for plants to absorb water. Summary of Methods: To test this hypothesis, we grew two sets of radishes, one treated with Gatorade and the other treated with tap water and measured their average height after two weeks of growth.

Materials: Menards-brand topsoil; standard greenhouse six-pack trays, radish seeds, tap water, Orange-flavored Gatorade, metric ruler.

Methods: Using a standard greenhouse six pack tray, we added Menards store-brand topsoil to each tray so that it was flush with the top of the tray. We made ½ inch indentations with our pinky finger into the soil of each compartment and added one radish seed per hole. We covered the hole with soil and moistened the soil with tap water. We then added 5 ml of Gatorade to each compartment. An untreated control was also made using the same methods. The trays of radishes were watered with 100 ml of water per day. After two weeks, we measured the height of the radishes in centimeters from the base where the seedling emerged to the highest point of the radish plant (after it was gently stretched).

Source: curlydock.wordpress.com

Results: After two weeks of growth, the radishes treated with Gatorade averaged 4.7 cm (n= 10) while the radishes in the control group were 5.2 cm in height on average (n=12) – see Fig. 1. The radishes in the Gatorade group also appeared to be slightly wilted and droopy. The radishes in the control group were a darker green and also appeared to stand more erect. Two radishes in the Gatorade group died before the experiment ended, possibly because of the Gatorade treatment.

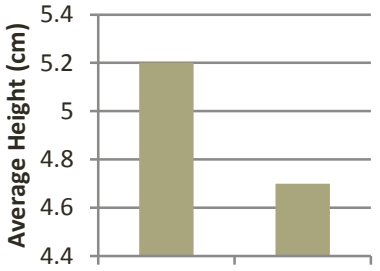


Fig. 1: As you can see in this graph, the radishes treated with Gatorade were 0.5 cm shorter on average than the plants in the control group.

Conclusion & Discussion: We hypothesized that treating radishes with Gatorade would increase the average height of those radishes. Our data does not support this hypothesis, as the radishes treated with Gatorade were 0.5 cm shorter on average than those in the control. We thought the Gatorade would help by adding more potassium and sodium to the plant so that the plant could better absorb water from the soil. However, from our observations it seemed as if the soil held onto the water more strongly, reducing the amount of water the plant could absorb. While further testing would be necessary, if this is the case it would mean that we would get smaller radishes every time we treated them with Gatorade. If we could find a way to directly inject the plants with Gatorade, it is possible that we could create larger, more productive plants in the same amount of soil and increase food production. Further experiments would be needed to test this

Bibliography & Works Cited

Baker, John et.al. (Nov. 2010). Plant Physiology. Harvard Press, Harvard MA

Univ. of Florida (Aug. 1965). Development of Fluids to Aid Athletic Performance. Journal of Kinesiology, Washington D.C.

UW Dept of Horticulture. (June 2009). Absorptive Capacity of Roots Systems. Retrieved from www.hort.wisc.edu/docs on Sept. 12th, 2012.

Sample Paper

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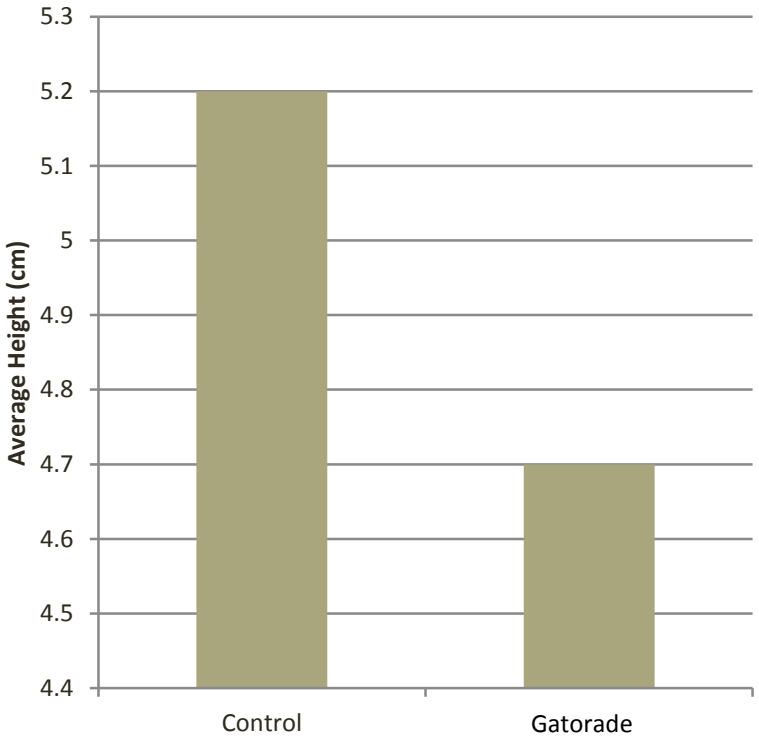

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