How to Write Research Proposals C. Kohn, Waterford WI

Name: Hour: Date:

A research proposal is the necessary first step of almost any research project. A research project must be thoroughly planned, submitted, and approved before it can be started. A research proposal is simply an orderly description of the work you want to perform.

A research proposal is just like a research poster, except that there is one major difference. In a research proposal, you are describing work that *will* happen in the future (unlike a research poster where your work has already happened). When writing about what you propose to do, use the future tense. In other words, you should write about what you *will* do, not what you have done. “We *will be giving* one group 8 oz of coffee and another group 8 oz of water” would be correct. “We *gave* one group…” would be incorrect.

The ingredients of a research proposal are almost the same as a research poster: **Title, Introduction, Methods, Expected Results, and Conclusion (or Discussion).** A research proposal will also have a **bibliography** of cited sources.

1. **Introduction**: Your introduction should begin with a brief (3-5 sentences) explanation of your topic. If you’re intending to study the effectiveness of different fertilizers, you would want to begin with a discussion of the fertilizers help plant production. If you were studying the rate of weight gain in chickens, you would want to discuss the factors that affect animal growth. If you intended to study the effects of caffeine on the heart, you would discuss how the heart rate is controlled by the body. Your introduction should begin with a few key statements about your study subject.   
     
   Your introduction should then move on to describe your **research question**, your **hypothesis**, and your **rationale**. This is the “we wondered…we predict…we thought this because…” portion of your paper. What are you trying to figure out? This is your research question. What do you think will happen? This is your hypothesis. Why do you think your hypothesis is right? This is your rationale.

**Research Question**: We wondered if…

**Hypothesis**: We predict that…

**Rationale**: We think this will happen because…

1. **Methods**: This is probably the most important section of a research proposal. This is what an evaluator would use to determine whether or not they think your experiment is going to work. You will want to be very specific with your methods. Your likelihood of not getting approved is greatest with a poor methods section.   
     
   DO NOT assume your reader knows anything about your experiment! They do not. Because of this, your methods section cannot be lacking in any details. Clearly specific step-by-step each portion of how your experiment will work. Clearly address how your experimental design will specifically test your hypothesis. For example, if you plan to see how different pesticides affect plant growth, you better be measuring plant height and nothing else unrelated to the growth of the plant! Measuring “green-ness”, survival, or productivity does not relate to your hypothesis, and either the hypothesis or the methods need to change.
2. **Expected and Alternative Results**: Since you have not yet done the experiment, you will not have any data. However your hypothesis should state what you expect to happen. Make a graph that shows what your hypothesis predicts. Be sure to label all components of the graph so that someone could understand it without reading the text! For example, we might create the following graph for the coffee experiment (next page)

Your results should include both a graph (with a caption!) as well as a paragraph of descriptions of what you think will happen.



1. **Discussion**: always begin a discussion by repeating your hypothesis. “We are hypothesizing that…” is a great first sentence for any discussion in a proposal. Then discuss how your experiment will effectively test this hypothesis. This is your last chance to convince your reader (and source of funding) that this experiment will be effective. **Explain how you know this experiment will work. Also explain anything you are assuming that would be necessary for your experiment to work (e.g. you are assuming the greenhouse will be heated).**   
     
   Scientists also tend to be very cautious in making predictions. Your discussion should NEVER say “We know this is going to work” if you don’t know for sure if it’s going to work (trust me…you won’t know for sure). **Discussing the limitations of your experiment and how you will minimize their impact is a very convincing way to show your reader that you have a well-planned experiment.** Always describe the limiting factors of your experiment. For example, 10 people is a small number for an experiment– it would be better to have more people, and it should be explained in your discussion why you don’t have a greater number (e.g. because we only have 20 people in the class). Conclude by discussing your confidence in your experiment’s ability to test your hypothesis.
2. **Bibliography**: anything that is not common knowledge needs to be cited! Use the parenthetical author-date system preferred by most scientific journals. Always give the last name of the author(s) and the date the work was published in parentheses after major statements. For example: *Global warming is a looming threat to biodiversity* **(Peters and Lovejoy 1992).**

At the end of your paper, you should list all your sources. The following format would be ideal:

- Kuhn, T.S. 1962. The structure of scientific revolutions. University of Chicago Press, Chicago

*Sample Paper*

**Consumption of Coffee by Students May Cause Increased Heart Rate (*subject, ind. and dep. variable, expected results)***

By: Craig Kohn (*name*)

7th Hour Agriscience (*class and hour)*

Waterford Union High School (*school*)

**Introduction**: Caffeine is known to cause changes in the metabolism and function of bodily cells (Vander, *et. al.,* 2004). From previous experience, I have felt my own heart rate increase after drinking coffee. This is important to know because caffeine can have major impacts on heart health (Harvard, 2008) (*background information*). I wondered if caffeine can increase the heart rate of a normal human being under normal circumstances (*experimental question*). I hypothesize that consuming an 8 oz cup of a caffeinated beverage will cause a measurable increase in heart rate within a half hour of consumption (*hypothesis*). This hypothesis is based on my own previous experience, as well as university research (Harvard Medical School, 2008) (*rationale).*

**Experimental Steps**

Step 1: Assign subjects to test or control replicates.

Step 2: Have subjects rest for five minutes in a char.

Step 3: Have subjects drink their respective drink within five minutes.

Step 4: Take subjects BPM with a stethoscope every five minutes from the time they begin consumption.

Step 5: Average all subject’s data according to whether they were in the control or test replicate.

Step 6: Graph data and confirm or reject hypothesis.

**Methods**: volunteers will be assessed one at a time. The 20 volunteers will be given appointment times; when they arrive, they will be asked to stay seated for 5 minutes to allow their heart rates to decrease. They will be asked to draw a card from a hat; in this hat will be 10 red cards and 10 black cards. Red cards will be used for the coffee group and black cards will be used for the water control. After five minutes, the subject’s heart rate will be measured over 10 seconds with a stethoscope, and then multiplied by 6 to get the BPM. The subjects will then be asked to consume their respective beverage over a five minute period. The beverage will be 8 oz regardless of if it is coffee or water. The coffee and water will be kept at the same 100o F temperature to reduce variation.

After they have consumed their beverage and five minutes has passed, the subjects’ heart rates will be measured every five minutes with a stethoscope. The subjects will remain seated throughout the experiment. This data will be entered, and the data for each subject at each interval will be averaged with all other subjects to get the average BPM for each interval for both the control and test groups. This data will then be analyzed and compared.



**Expected Results**: because it is well established that caffeine causes the heart rate to increase, I fully expect that the subjects that drink coffee will have a higher heart rate than those who drank water. The graphed averages should show a BPM that is statistically significantly higher than the water control after an undetermined amount of time (Fig 1) However, I do not know how much it will increase, or how fast. It is possible that their heart rate may not increase at all. This is unlikely but possible. For example, if some outside factor caused everyone’s heart to beat faster, it might overshadow the effects of the caffeine. As such, it will be highly important to minimize all outside influences and keep the laboratory setting as controlled as possible. (*description of expected results*).

**Discussion**: I am hypothesizing that consuming 8 oz of a caffeinated beverage will increase the heart rate of student participants compared to those in a control (*restated hypothesis*). Because we can easily and reliably measure heart rate with a stethoscope, this experiment should be effective in measuring the effects of caffeine (*how methods will effectively test hypothesis*). I expect that the increase in heart rate will be gradual and taper off after reaching its peak influence (see Fig. 1). However, this will most likely occur under the assumption that there is not another unnatural cause of increased heart rate in the room at the time. For example, if the students who were drinking water also had an exam the next hour, their heart rates might be higher solely because of coincidence (*description of assumptions)*. While this is unlikely, it shows that our experiment could fail if our assumption that coffee is the only increaser of heart rates in the room is proven incorrect. Limiting factors include the small number of project participants. This is unfortunate but unavoidable due to the small size of the class. It would also be better to measure their hearts with more sensitive equipment than a stethoscope. Again limiting factor is that our class is limited in size. Finally, I am concerned about the placebo effect, where subject’s heart rates may rise solely because they think it should. A non-caffeinated coffee control might be more effective along with water for a future experiment but due to budget limits, I am focusing on water vs. coffee alone (*description of limiting factors).*

Overall, I feel that this experiment will effectively test my hypothesis. I should be able to limit, as best as I can, all factors outside of coffee that would raise heart rate, and I have an effective control (*confidence about experiment)*. If the control subjects’ heart rate does not change significantly while the coffee drinkers’ does, I can be fairly certain that the cause was the coffee and nothing else. (*why you think experiment will go as planned).*

**Bibliography**

American Heart Association. 2008. Cardiovascular Disease Statistics. *American Heart Association Website.* [*http://www.americanheart.org/presenter.jhtml?identifier=4478*](http://www.americanheart.org/presenter.jhtml?identifier=4478)*.*  Accessed October 7th, 2008.

Harvard Medical School. 2008. Coffee Health Risks. Harvard Health Publications, Harvard Medical School website. <http://www.health.harvard.edu/press_releases/coffee_health_risk.htm>. Accessed October 7th, 2008.

Vander, *et. al.* 2004*.* Human Physiology. McGraw Hill, Boston, MA.

Tips and Hints:

1. **Make sure your hypothesis is TESTABLE**! A hypothesis is good when it relates to something that you can directly measure. “Green-ness” would be hard to measure and relate to plant growth. Height in centimeters would work much better.
2. **Include lots and lots and lots of details in your methods**. Take a few minutes and really think through how your experiment will work. Anticipate everything that can go wrong. Design your experiment to avoid these pitfalls and explain how you will prevent potential problems in your methods, results, and discussion.
3. **Be honest.** Your experiment will not be comparable to university or government research…and that’s ok. This is probably your first real experience in designing an experiment. It is good to address your limitations before you do your experiment. If size, space, money, skill, or time is limited, address this and explain how you will work around these limitations.

**Research Proposal Checklist:**

1. **Title**: Does your title have…
   1. The study subject
   2. The independent variable and the dependent variable(s)
   3. The expected results
   4. Your names, class, hour, and school
2. **Introduction**: does your introduction include…
   1. Relevant background information (3-5 sentences w/ parenthetical citation)
   2. The experimental question
   3. The hypothesis
   4. The rationale, or reason for your hypothesis
3. **Methods**: does your methods section include…
   1. A cook-book recipe-style description of how you will conduct this experiment?
   2. A diagram or flow chart describing your work in a visually simple but complete way?
4. **Expected Results**: does this section include…
   1. A graph with the anticipated results with…
      1. A legend
      2. Labeled x axis and y axis
      3. A caption with a description that allows it to stand alone
   2. A description of the expected results and trends in data
5. **Discussion:** does this section include…
   1. Your restated hypothesis
   2. A statement describing how your methods will effectively test this hypothesis.
   3. Description of assumptions
   4. A description of all of the limiting factors that will reduce the effectiveness or accuracy of your experiment
   5. Your confidence about this experiment and its ability to effectively support or reject your hypothesis
6. **Bibliography**: does this section include…
   1. All major sources, listing the…
      1. Author’s name (last name first, first name last)
      2. Date of publication
      3. Name of document
      4. Publishing agency
      5. Website and date accessed (*if from online*)
   2. Alphabetized listing by author’s last name (e.g. Arthur, J. would precede Baker, T.)
7. **General**
   1. Is your hypothesis testable? Do your methods relate to your hypothesis?
   2. Would the reader get a complete picture of what you intend to do?
   3. Could the reader repeat your experiment based on this paper without asking questions?
   4. Is it obvious and clear that you know what you expect to find and is this stated in the paper?
   5. Have you plagiarized material? Are you stealing ideas or giving proper credit? Is everything cited? Are your sources credible?
   6. Does your paper look professional and visually attractive?

### References

List all works cited in the text - and no others - alphabetically in the References section at the end of your paper. Each reference should include the names of all the authors, the date the article or book was published and/or the date the website was accessed and its title.

**Journal**

Include the author(s), title of the article (with only the first word capitalized), name and volume of the journal (italicize the name), and pages for the article.

Vitousek, P.M. 1994. Beyond global warming: ecology and global change. Ecology 75: 1861-1876.

Post, W.M., Emanuel, W.R., Zinke, P.J., and Stangenberger, A.G. 1982. Soil carbon pools and world life zones. Nature 298: 156-159.

***Internet Sources***

Include the author(s), title of the work (in quotation marks), title of the complete work or site, if applicable (in italics), website URL or address (except for personal email), and date of visit or message. (The method for citing online sources has not yet been standardized.)

**email:**

Carbon, J.J. "Physiology data." Personal email (7 July 01).

**World Wide Web**: Basic form is: Author. Date. Title. URL (Access date)

Waterman, M., Stanley, E., Soderberg, P., and Jungck, J.R. 10 August 1999 "Kingdoms entangled: molecules, malaria, and maise." BioQUEST Curriculum Consortium.<http://bioquest.org/case.html> ( April 12, 2000 )

Macreal, Holly. 10 April 2001 "Large Fish, Small Pond." <http://www.bigfish.org/articles> ( April 20, 2001 )

Whenever possible, list the author. If you can’t find an author, list the organization that provided the information. If you can’t find the name of the organization, question the quality of your source.

***Book***

Include the author(s), title (italicized, with only the first word capitalized), edition number (if it is not the first edition), the publisher, the city of publication, and the state (omit the state for well known cities like New York ).

Kuhn, T.S. 1962. The structure of scientific revolutions. University of Chicago Press, Chicago.

Purves, W.K., Sadava, D., Orians, G.H., and Heller, H.C. 2001. Life, the science of biology, 6th ed. Sinauer, Sunderland , MA.

***Chapter in a Book***

Naes, A. 1986. Intrinsic value: will the defenders of nature please rise? In Soulé , M.E. , editor. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland , MA . pp. 504-515

Writing a Research Proposal *by C. Kohn*

Name: Hour Date:

Date Assignment is due: Score: : + ✓ -

A hypothetical group is interested in doing research on how different kinds of light affect the growth of radishes. Answer the questions below as they relate to the area of research of this group. You can work with your group to answer the questions below but each person is responsible for completing and submitting their own sheet.

1. If a group is doing a research proposal on how differently colored light affects radish growth, what would be an effective title for their proposal? Write it below:  
     
      
     
      
   *Remember, a title includes the study subject, the independent variable, the dependent variable, and the expected results. It should also have the names, class, and institution below.*
2. What might be a good research question for this group?  
     
   “We wondered if…
3. What might be a good hypothesis for this group?  
     
   “We predict that…
4. What might be a good rationale for this group?  
     
   “We think this will happen because…
5. How could this group test their hypothesis? Use as many of the steps as you need.   
     
   Step 1:   
     
   Step 2:   
     
   Step 3:   
     
   Step 4:   
     
   Step 5:   
     
   Step 6:   
     
   Step 7:
6. What might this group’s graph of their expected results look like? Draw a graph below.  
     
     
     
     
     
     
     
     
     
   *Remember to label both axes and all bars, lines, or sections.*
7. What would be a good caption for this graph? Write your caption for this graph just like the caption in the example paper.
8. What assumptions might this group make that would be key for their experiment to work? In other words, what factors (temperature, light, water, etc.) should be a given and are necessary for their experiment to go as planned?
9. What factors might limit the effectiveness of their experiment? How might class size, funding, experience, resources, or other limitations affect the outcome of their work?