

An Introduction to Experimental Research

What is Experimental Research? Experimental research is a study that strictly adheres to a scientific research design. It includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated and compared. Most importantly, experimental research is completed in a controlled environment. The researcher collects data and results will either support or reject the hypothesis. This method of research is referred to as hypothesis testing or a deductive research method (Babbie 4).

What is the Purpose of Experimental Research? Experimental research seeks to determine a relationship between two (2) variables—the dependent variable and the independent variable. After completing an experimental research study, a correlation between a specific aspect of an entity and the variable being studied is either supported or rejected.

What type of Data are Collected in Experimental Research? Data in experimental research must be able to be quantified, or measured. Data collected could be acidity/alkalinity, area, circumference, density, electrical current/potential/resistance, force, growth (time, weight, volume, length/width), heat, humidity, light intensity, mass, pressure, sound intensity, temperature, time, velocity, volume or weight. However, the entity should be carefully observed qualitatively, or described using words and photographs. How does the entity look, smell, sound, feel, and taste (when appropriate)? These types of observations help supplement the measurements taken throughout the experiment.

What Types of Experiments are Considered Experimental Research Projects?

Forensic Studies—Studying splatter (a physics/math study), decomposition (an entomology study), damage to objects (a physics/engineering study), can be done in a controlled environment and be measured.

“The Effect of _____ on _____” Studies—All experimental studies look to determine how one thing affects another.

Product Effectiveness—If a specific aspect (active ingredients, size of crucial components etc...) of several products can be determined to be in different quality or quantity, this makes for a great experimental project. (For example the different levels of Ethyl Alcohol within antibacterial hand sanitizers.)

Microbiology—bacteria (and some protists) grow quickly, change in population is easily measured and therefore make for a good experimental study.

An Introduction to Exploratory Research

What is Exploratory Research? Exploratory research is a study that seeks to answer a question or address a phenomenon. The nature of the entity being studied does not allow a variable to be manipulated by the researcher, it cannot be completed in a controlled environment, or most likely, the researcher can't determine all the influences on the entity, therefore a more exploratory look at the topic is more beneficial. This type of research seeks to identify general principles to explain data and observations, and is also known as the inductive method (Babbie 4).

What is the Purpose of Exploratory Research? The purpose of exploratory research is to investigate a specific phenomenon. Exploratory research seeks to learn as much as possible between two variables—the dependent variable and the independent variable. The exact nature of the dependent variable may not be known or understood before the experiment begins, and therefore, is observed and recorded more holistically. After completing an exploratory research study, a description of the relationship between the two variables is explained. It is likely that from an exploratory study, an experimental study could be done, because the relationship between the variables has been established.

What type of Data are Collected in Exploratory Research?

The types of data collected for an exploratory research are likely the same as an experimental study. However, exploratory research is unique because the data are either collected “in the field” or the data already exists, and must be organized in a way that has not been done before. It is important to note here that a study that includes collecting field data does not necessarily mean the study must be exploratory. Additionally, depending on the nature of the study, it is possible that data be collected through interviews or surveys. Large volumes of data are collected for exploratory research, because the data must then be analyzed from many different perspectives, looking for possible relationships between the variables. The observations/data of exploratory research are what leads to an inductive conclusion, rather than the acceptance or rejection of a hypothesis, like experimental research. Instead, the results are considered a tentative conclusion because the observations made are not a test of the pattern, but the source of the pattern identified (Babbie 59)

Consider the possibility of using data that is available free on the web. Organizations, government agencies as well as private corporations often make raw data available and accessible to the public. In this case, your research wouldn't focus on how you obtain the data; rather, it focuses on what you choose to do with the data, and how you compare it to your variable. The purpose here is to look for patterns that may lead to a new previously unknown correlation.

What Types of Experiments are Considered Exploratory Research Projects?

Product effectiveness—you might not know how to define effectiveness, or have any way to manipulate a variable, so by doing an exploratory study, you seek to describe the relationship holistically.

Long-term studies—while you don't have time to do a longitudinal study yourself, you might be able to find data that already exists, that you can use to investigate a specific phenomenon. Talk to a librarian about existing databases, or contact an expert in the content area.

Forensic Studies—comparing past crime scene data to look for patterns.

Human Genetic Studies & Population Studies—These must be exploratory studies because you cannot manipulate propagation of humans! Instead you collect existing data, and look for connections between your variables.

Meteorology studies—Comparing weather patterns (existing data) from around the world looking for connection between your variables.

Mathematical Studies—Using mathematics to solve problems may, or may not involve two clear variables. Or the research question may change as data are collected to address the initial phenomenon. These studies may use publically existing data, but the researcher is looking for patterns between two variables.

Behavioral Studies—Observing behavior is best done in the entities natural environment. You may not know all the existing behaviors you will measure, so exploratory research best fits this type of research.

Ecological Studies—While some entities might transfer to a controlled environment just fine, if the collection of data can occur in the natural environment, this may be preferred.

Works Cited

Babbie, Earl. The Practice of Social Research. 8th ed. Detroit: Wadsworth Publishing Company, 1998.

Parts of the Job Shadow Paper

(Teachers: Note: These are specific requirements one teacher made of her students, not necessarily requirements of the ISU High School Research Symposium. Feel free to edit and change the information below to suit your needs.)

Introduction:

- ❑ Do NOT use “I” in this section.
- ❑ This section should introduce your topic—approximately one paragraph.
- ❑ **Describe how the paper/poster will be organized.**
 - ❑ *Example:* This paper has seven sub-sections. The paper begins with a description of the history of pathology. Then varying procedures that pathologists do will be discussed. Then a detailed explanation of the job shadowing experience will follow. Next the...
- ❑ The purpose of this section is to set the stage for the rest of the paper. After reading this section, the reader should know exactly what is coming.

Sub-Sections

- ❑ Take several areas of the job shadowing experience and focus in on them in detail.
 - ❑ *Sample sub-sections:* certain scientific procedures, education to get into the field, or describing the anatomy/science/math of the field.
 - ❑ But one section can be dedicated to describing the events of the actual job shadowing experience. (May use “I” for this section only.)
- ❑ The paper you turn in must be divided into sub-sections. These are based on the 5+ questions that you used to drive the research and note taking process. Take your research questions and make them into topic sentences.
- ❑ You are to organize the paper into logical sub-categories that the reader will be able to follow.
- ❑ Be conscious that the order of these sub-sections is logical and meaningful. Be sure to define scientific words the first time they are used.

MLA Documentation:

- ❑ This is a ***HUGE*** part of this paper. Probably every section in your paper will have ideas that you did not know before you started the research and therefore must be documented.
- ❑ **Research:** You will take a lot of notes for this paper. You will have a minimum of eight (8) MLA documentation sheets filled with information from which you will write the paper.
- ❑ **Within the Paper:** Use parenthesis with author’s last name and page number often. You cannot overuse this. With research papers, most everything you will be writing will be ideas from other people, so expect your paper to be littered with parentheses.
- ❑ **Works Cited:** Be sure that all sources referenced are found in the Works Cited. Remember, what ever is in parenthesis, must be what you alphabetize by in the Works Cited. AND, if a resource is in the Works Cited it must be cited in the paper.

Body Paragraphs:

- Depending on how many sub-sections you have, each section will have multiple paragraphs.
- Topic Sentences: Be sure that each sentence of each paragraph tells the reader what the paragraph is about. All sentences under the TS should refer to the first sentence.
- Be sure that paragraphs flow. Use organizational transitions to make the paper sound fluid.
- Be sure to not use scientific words and/or concepts before they've been explained.
- Don't make assumptions of what your reader knows. When in doubt explain it!
- **Stay organized and on topic. Be careful not to babble!**
- You should not use "I" or any other form of first person in this research paper.
 - If you job shadowed you may use "I" to explain the events of your experience.
 - **Get approval for using in "I" in any other section.**
- Do not use second person anywhere in this paper. (You)
- You must have all notes in your own handwriting FIRST, BEFORE using it in the text of your paper or plagiarism will be assumed.
- Paragraphs should be full of facts that were researched, but the paragraph structure in which the facts are found is your own writing. Use your ideas to glue all the facts together. Be VERY careful not to plagiarize.

Figures:

- While you won't necessarily have graphs like students doing experimental papers, you may have come across some information that can be displayed in a table or graph. You may choose to use it. If you do this, be sure that you **reference the information in where it came from.**
- Figures should be numbered in the order that they are discussed in the paper and must be in the order that they are referred to in your paper.
- Graphical representation of data can be in any of the following forms:

Circle graph Bar or line graph Table Photographs	}	All are labeled as "Figure"
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- When you use figures, **you must also have narrative** within the paper that **explains** what it displays.
- Graphs: **MUST** be labeled (words and units) and have titles. However, Graphs, photos, tables are ALL labeled as Figures.
 - Example: Right above a photograph may be the following:
 Figure 1: Stem Growth in cm. of Plants Watered with Mountain Dew after Two

Weeks

- When referring to figures in the text of your paper you can either put it at the end of the sentence in parentheses or work it into the sentence itself
 - *Example:* While the shrimp colonies in the 7.8 pH water were the quickest group to multiply the first few days of the experiment, the red line in figure 4 shows, the colony number steadily decreased until no shrimp were left on day 20.
- Figures too big to put in the paper should be put in an Appendix that is put before the Works Cited. These too must be referred to in the paper. Number them in order they are referred to in the paper. (Appendix 1, Appendix 2, etc.)

Content:

- ❑ Content must be a biology/science topic and must be covered in detail appropriate for a high school student.
- ❑ When you write the paper, you will research the job in general, and then you should choose to focus on some specific case, incident, aspect or experience that you had during day.
- ❑ In the paper, be sure to **connect** the research you did with your job shadowing experience.
- ❑ All research must be true and reflect scientific fact and documented MLA style.
- ❑ No major gaps in topic. Reader isn't left with a lot of "Why?" questions.
- ❑ Author's opinion on the topic is not blatantly obvious.
- ❑ ALL research details in paper can be found in note packet.
- ❑ Documentation litters the paper.

Personal Reflection: 1-2 pages (You may use "I" for this section.)

The following questions MUST be addressed in the reflection.

- ➔ Explain why this scientific career is important to the scientific community as a whole.
- ➔ What questions now immerge from completing your research? What else do you want to know about this career? (There will always be new questions. Remember our class motto!)
- ➔ How has this experience changed your view of this profession? Are you more/less interested in going into this field then before the job shadow experience? Explain.

Reflective Questions

The following questions are just guidelines for you to use in the remaining portion of the reflection section. It doesn't matter which questions you answer out of this first list and you may choose topics that are not here. But your reflections must be real, specific and honest.

- ❑ Why did you choose this science career? What made you curious about it?
- ❑ Did you find out what you thought you would or something different?
- ❑ How has this topic helped you see Biology in a new light?
- ❑ What about this topic would you liked to have been able to find more about? Explain.
- ❑ What would you do differently if you had the opportunity to re-do this paper?
- ❑ Did you have frustrations with the research or paper?

Job Shadow Details:

- ❑ You must set up the experience through your own contacts.
- ❑ Before you go, write out questions that you want to have answered. Have those questions approved before you go.
- ❑ Do some research before you shadow. That way you can ask intelligent questions.
- ❑ Dress appropriately for the type of job you are experiencing. Do not wear jeans or t-shirts. Stay away from real trendy clothes and dress professionally. Because you are being invited to observe, you can NOT over dress. You are representing Gridley High School so be on your best behavior.
- ❑ Take photographs at some point during your day (Proof of your experience.) You **must** have at least one photograph of you at your job site.
- ❑ After the job shadow experience, write a handwritten thank-you note to the individual(s) who allowed you to follow them around. They did you a big favor, show your sincere thanks. Make a copy of the note(s) to turn in with your paper.