Communication within the Sciences

Communication in the field of science is how new knowledge is shared. Scientists communicate daily with other scientists, government officials, and the general public. Written forms of communication used by scientists usually take one of four forms:

1. Informal Laboratory Report
2. Formal Laboratory Report
3. Scientific Literature Review Research Paper
4. Scientific Experimental Research Paper

The first two are the most common. Typically, lab reports do not require research, however they do require an organized scientific thought process. The last two require research as well as an organized thought process.

On the following pages are the formats chosen by the science department at David Brearley Middle and High School for science communications.
Review of the Scientific Process (Scientific Method)

The process of answering science questions through experimentation is done in an organized fashion. If posed a question in daily life, you usually follow a process that is similar to the scientific process. However, you usually do not spell out the steps. In science, it is imperative that you communicate the process clearly, so that your work can be duplicated and verified.

Steps of the scientific process

I. Initial observation: This is when you notice something in your environment that leads to a question or defines a problem.

II. Prediction: After some thought about the problem or question, you will have ideas about what the solution to the problem or answer to the question will be if you test the problem in certain ways. Predictions about solutions or answers are typically recorded in “if…then…” statements.

III. Hypothesis: This is a more formal statement of your prediction that is not typically in “if…then…” form. An hypothesis states what you are going to do and how you are going to do it.

IV. Experimentation: This is the step by step procedure that you follow to come to what you believe is the solution to the problem.

V. Observation: Careful observation of your experiment is vital to your understanding of whether or not you have solved your problem.

VI. Analysis: Understanding the results of the experimentation, by analyzing the observed results is the most crucial step in the entire process. Questions of what happened in the experiment, how it happened, and why it happened should have clear answers. If any of these questions do not have clear answers, then more questions are presented. To answer these questions, you continue the scientific process in successive experiments.

VII. Conclusion: Very simply put, this is where you state whether or not you solved the problem you posed or answer the question you asked.
General Rules for Scientific Communication

Scientific communications are not literary essays. Science writing should follow these rules:

1. **No First Person Pronouns!** The scientific community does not personalize anything in formal writing. “WE” did not discover anything, “IT” was discovered through the following experimentation that….

2. **No Fluff!** The scientific community doesn’t care that “the red precipitate was as crimson as…” The scientific community cares that “a red precipitate was formed, it weighed 13g, was insoluble in water, soluble in alcohol and caused a 55% increase in the rate of bladder cancer in lab rats.”

3. **Sections Please!** Scientific writing does not flow from paragraph to paragraph via transition words and phrases. Scientific writing is separated into sections with subtitles, etc. The paragraphs within the sections should be coherent. However, the ending thought of one section does not necessarily lead into the next section.

4. **Organization, Organization, Organization!** Scientific writing generally follows a format that reflects the methodical scientific process.

5. **Title Page!** Every paper or report for school should include a separate title page that consists of the following: your name, the names of your partner(s), and the date(s) that the experiment was performed, at the top center. Centered in the middle should be the title of the paper/name of the experiment with appropriate capitalization. Centered at the bottom should be the course information, the teacher, the course title, the period and/or day that the class meets.
Informal Laboratory Report Format

You will use this type of format most often. Generally, your teachers provide procedures for an experiment or activity. Therefore, it may not be necessary to provide them with information that they have already given to you. Below are the sections to be included in an informal laboratory report.

I. Title Page: As described on the previous page.

II. Purpose/Hypothesis: This section is your hypothesis (hypotheses) in bulleted statement(s).

III. Procedures: If you are required to describe the process, this is where you do so.

IV. Observations: This section should include the observations made and data collected throughout the experiment. It needs to be organized and clearly stated. Data tables, graphs, etc. are expected. You should also include analysis of percent error, if required.

V. Discussion/Analysis: This section discusses whether or not you have proven your hypothesis/accomplished your purpose. It should be long enough to discuss what portions of your observations support your purpose. If your observations do not support your purpose, you must explain why, how the experimental procedure failed, and how you would change the experimental procedure for further experimentation.

VI. Conclusion: This section restates the purpose of the experiment, and whether or not you have proven the hypothesis. It should be a brief statement of no more than five sentences.
Formal Laboratory Report Format

Formal laboratory reports are used when the experiment is your original idea. If you have designed the experiment yourself, or have adapted the experiment of someone else, the findings need to be reported in the formal format. The formal laboratory report requires the following sections:

I. Title Page

II. Abstract: This is a paragraph, on its own page, summarizing each section of the paper. Each section should be represented by only one or two sentences. Abstracts should not be more than 350 words.

III. Background Information: This section includes any information that you have acquired in prior learning that is relevant to this lab. It may include references to similar experiments done by other people. This section should be written with your audience in mind, and should include citations when referring to the work or writings of other people.

IV. Purpose/Hypothesis: This section is your hypothesis (hypotheses) in bulleted statement(s).

V. Materials: This is a detailed list of the materials you used to do the experiment. It should be specific and accurate as to quantities and measurements. Chemicals used should be listed with exact amounts. If multiple pieces of equipment were used, the number of items should be included.

VI. Procedures: This should be a step by step description, in order, of the steps taken in the experiment. Again, the more specific the better. Another scientist should be able to take this list of steps and recreate the experiment under the exact same conditions.

VII. Observations: This section should include the observations made and data collected throughout the experiment. It needs to be organized and clearly stated. Data tables, graphs, etc. are expected. You should also include analysis of percent error, if required.

VIII. Discussion: This section gives evidence for whether or not you have proven the purpose/hypothesis. Compare your findings with the findings of others who you have previously mentioned in the background section. Any errors that may have affected your results should be discussed. Any questions for further research that have been raised during the experiment should be stated here.

IX. Conclusion: This section restates the purpose of the experiment, and whether or not you have proven the hypothesis. It should be a brief statement of no more than five sentences.
Scientific Literature Review Research Paper Format

Literature review research papers summarize the published articles on recent work that has been done, or is being done on a particular topic. Literature reviews usually do not introduce new material. However, they may suggest where the research on the topic may go in the future. These papers are not simply book reports. Reviews should integrate, interpret, and expand upon current information available about a topic. A good structure for a review paper should include, but is not limited to, the following sections:

I. Title Page

II. Abstract: This is a paragraph, on its own page, summarizing each section of the paper. Each section should be represented by only one or two sentences. Abstracts should not be more than 350 words.

III. Introduction: Typically left unlabeled, relatively brief (a page or less). Focuses on what will be included in the body, and provides an objective for the paper (the thesis). As with essays in other subject areas, it is a good idea to begin by giving the reader an idea of why this topic is important or interesting.

IV. Body: This may have several subsections when appropriate. Examples include, History, Diagnosis, Complications, Therapy, etc.

V. Discussion: This section is an opportunity for the integration, interpretation, and expansion of the current information. The body may present this work in a very factual nature, where this section does the synthesizing of the information. Also mentioned here is where the research may go in the future.

VI. Conclusion: This section restates the purpose of the experiment, and whether or not you have proven the hypothesis. It should be a brief statement of no more than five sentences.

VII. Acknowledgements: This is a place to thank the people who helped with research, organization, editing, etc.

VIII. Works Cited: This section should follow the Kenilworth School District Format for Works Cited (based on MLA). Often, in college, science papers are formatted following the American Psychological Association (APA) style manual, which organizes the references according to date rather than just alphabetically.
Scientific Experimental Research Paper Process

An experimental research paper requires that you conduct an experiment. Below is a methodology for completing this kind of project.

I. Formulate a question: Think about the problem and create an hypothesis.

II. Research current information: If you find the answer to the question, continue to research the topic. New questions may be formulated as research is done.

III. Take notes on the available information, and keep a list of each source from which you gather information. You will need to refer to (cite) the work that has been done by others in this field in the literature review or background section of your paper.

IV. Refine your question, and formulate an hypothesis.

V. Design an experiment to test your hypothesis.

VI. Perform the experiment recording data and observations in detail.

VII. Analyze the data. When looking at the recorded data and observations, answer the following kinds of questions:
   A. Is the data consistent?
   B. Did what occurred match your expectations (why or why not-5 reasons)?
   C. How does your data compare with what other people have found?
   D. If you have numerical data, you may need to calculate percent error according to this formula: \( \frac{(\text{actual value} - \text{experimental value})}{\text{actual value}} \times 100 \). You may wish to report the absolute value of this result.
   E. Does the data answer the question you asked?

VIII. Make conclusions. Based on your analysis, if your findings are surprising, make sure you can explain why, repeating the experiment if necessary. What did you learn?

IX. Write the paper following the format on the next page.
Scientific Experimental Research Paper Format

Experimental research papers present an experiment performed by the author. This format is used for controlled lab experiments, field experiment, or theoretical or mathematical investigations.

I. Title Page: The title should be concise, specific and informative. Generally try to keep it to fewer than 14 words.

II. Abstract: This is a paragraph, on its own page, summarizing each section of the paper. Each section should be represented by only one or two sentences. Abstracts should not be more than 350 words.

III. Introduction: This section includes any information that you have acquired in prior learning that is relevant to this lab (literature review). It may include references to similar experiments done by other people. This section should be written with your audience in mind, and should include citations when referring to the work or writings of other people. In addition, it states the objectives of the experiment. Start by discussing the general background, and become more specific until you state the objective.

IV. Methods: This section is written in the past tense. Simply and specifically state the procedures followed in the experiment. Include discussion of the independent variables, dependent variables, and why these variables were used. Describe the equipment used, including its manufacturer, model number, or if it was developed specifically for this experiment.

V. Results: Discuss your analysis of the data gathered. Present any new facts you discovered. Explain exactly what the results mean, using strong declarative statements (NO “it seems,” “this may have happened,” etc.). Be clear and definite.

VI. Discussion: This section gives evidence for whether or not you have proven the purpose/hypothesis. Compare your findings with the findings of others who you have previously mentioned in the background section. Any errors that may have affected your results should be discussed. Any questions for further research that have been raised during the experiment should be stated here.

VII. Acknowledgements: This is a place to thank the people who helped with the design of the experiment, funding or provision of materials/equipment, research, organization, editing, etc.

VIII. Works Cited: This section should follow the Kenilworth School District Format for Works Cited (based on MLA). Often, in college, science papers are formatted following the American Psychological Association (APA) style manual, which organizes the references according to date rather than just alphabetically.