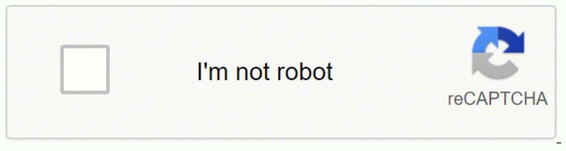

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What is the primary purpose of writing a lab report to summarize the rules of the laboratory

A lab report conveys the aim, methods, results, and conclusions of a scientific experiment. The main purpose of a lab report is to demonstrate your understanding of the scientific method by performing and evaluating a hands-on lab experiment. This type of assignment is usually shorter than a research paper. Lab reports are commonly used in science, technology, engineering, and mathematics (STEM) fields. This article focuses on how to structure and write a lab report. Structuring a lab report The sections of a lab report can vary between scientific fields and course requirements, but they usually contain the purpose, methods, and findings of a lab experiment. Each section of a lab report has its own purpose. Title: expresses the topic of your study Abstract: summarizes your research aims, methods, results, and conclusions Introduction: establishes the context needed to understand the topic Method: describes the materials and procedures used in the experiment Results: reports all descriptive and inferential statistical analyses Discussion: interprets and evaluates results and identifies limitations Conclusion: sums up the main findings of your experiment References: list of all sources cited using a specific style (e.g. APA) Appendices: contains lengthy materials, procedures, tables or figures Although most lab reports contain these sections, some sections can be omitted or combined with others. For example, some lab reports contain a brief section on research aims instead of an introduction, and a separate conclusion is not always required. If you're not sure, it's best to check your lab report requirements with your instructor. Title Your title provides the first impression of your lab report – effective titles communicate the topic and/or the findings of your study in specific terms. Create a title that directly conveys the main focus or purpose of your study. It doesn't need to be creative or thought-provoking, but it should be informative. Title examples The effects of varying nitrogen levels on tomato plant height. Testing the universality of the McGurk effect. Comparing the viscosity of common liquids found in kitchens. Scribbr editors not only correct grammar and spelling mistakes, but also strengthen your writing by making sure your paper is free of vague language, redundant words and awkward phrasing. See editing example Abstract An abstract condenses a lab report into a brief overview of about 150–300 words. It should provide readers with a compact version of the research aims, the methods and materials used, the main results, and the final conclusion. Think of it as a way of giving readers a preview of your full lab report. Write the abstract last, in the past tense, after you've drafted all the other sections of your report, so you'll be able to succinctly summarize each section. To write a lab report abstract, use these guiding questions: What is the wider context of your study? What research question were you trying to answer? How did you perform the experiment? What did your results show? How did you interpret your results? What is the importance of your findings? Example: Abstract Nitrogen is a necessary nutrient for high quality plants. Tomatoes, one of the most consumed fruits worldwide, rely on nitrogen for healthy leaves and stems to grow fruit. This experiment tested whether nitrogen levels affected tomato plant height in a controlled setting. It was expected that higher levels of nitrogen fertilizer would yield taller tomato plants. Levels of nitrogen fertilizer were varied between three groups of tomato plants. The control group did not receive any nitrogen fertilizer, while one experimental group received low levels of nitrogen fertilizer, and a second experimental group received high levels of nitrogen fertilizer. All plants were grown from seeds, and heights were measured 50 days into the experiment. The effects of nitrogen levels on plant height were tested between groups using an ANOVA. The plants with the highest level of nitrogen fertilizer were the tallest, while the plants with low levels of nitrogen exceeded the control group plants in height. In line with expectations and previous findings, the effects of nitrogen levels on plant height were statistically significant. This study strengthens the importance of nitrogen for tomato plants. Introduction Your lab report introduction should set the scene for your experiment. One way to write your introduction is with a funnel (an inverted triangle) structure: Start with the broad, general research topic Narrow your topic down your specific study focus End with a clear research question Begin by providing background information on your research topic and explaining why it's important in a broad real-world or theoretical context. Describe relevant previous research on your topic and note how your study may confirm it or expand it, or fill a gap in the research field. Example: Referring to previous research This lab experiment builds on previous research from Haque, Paul, and Sarker (2011), who demonstrated that tomato plant yield increased at higher levels of nitrogen. However, the present research focuses on plant height as a growth indicator and uses a lab-controlled setting instead. Next, go into detail on the theoretical basis for your study and describe any directly relevant laws or equations that you'll be using. State your main research aims and expectations by outlining your hypotheses. Example: Stating your hypothesis Based on the importance of nitrogen for tomato plants, the primary hypothesis was that the plants with the high levels of nitrogen would grow the tallest. The secondary hypothesis was that plants with low levels of nitrogen would grow taller than plants with no nitrogen. Your introduction doesn't need to be long, but you may need to organize it into a few paragraphs or with subheadings such as "Research Context" or "Research Aims." Method A lab report Method section details the steps you took to gather and analyze data. Give enough detail so that others can follow or evaluate your procedures. Write this section in the past tense. If you need to include any long lists of procedural steps or materials, place them in the Appendices section but refer to them in the text here. You should describe your experimental design, your subjects, materials, and specific procedures used for data collection and analysis. Experimental design Briefly note whether your experiment is a within-subjects or between-subjects design, and describe how your sample units were assigned to conditions if relevant. Example: Experimental design A between-subjects design with three groups of tomato plants was used. The control group did not receive any nitrogen fertilizer. The first experimental group received a low level of nitrogen fertilizer, while the second experimental group received a high level of nitrogen fertilizer. Subjects Describe human subjects in terms of demographic characteristics, and animal or plant subjects in terms of genetic background. Note the total number of subjects as well as the number of subjects per condition or per group. You should also state how you recruited subjects for your study. Materials List the equipment or materials you used to gather data and state the model names for any specialized equipment. Example: Materials List of materials 35 Tomato seeds Soil 15 plant pots (15 cm tall) Water Light lamps (50,000 lux) Nitrogen fertilizer Measuring tape Describe your experimental settings and conditions in detail. You can provide labelled diagrams or images of the exact set-up necessary for experimental equipment. State how extraneous variables were controlled through restriction or by fixing them at a certain level (e.g., keeping the lab at room temperature). Example: Experimental settings Light levels were fixed throughout the experiment, and the plants were exposed to 12 hours of light a day. Temperature was restricted to between 23 and 25℃. The pH and carbon levels of the soil were also held constant throughout the experiment as these variables could influence plant height. The plants were grown in rooms free of insects or other pests, and they were spaced out adequately. Procedures Your experimental procedure should describe the exact steps you took to gather data in chronological order. You'll need to provide enough information so that someone else can replicate your procedure, but you should also be concise. Place detailed information in the appendices where appropriate. In a lab experiment, you'll often closely follow a lab manual to gather data. Some instructors will allow you to simply reference the manual and state whether you changed any steps based on practical considerations. Other instructors may want you to rewrite the lab manual procedures as complete sentences in coherent paragraphs, while noting any changes to the steps that you applied in practice. If you're performing extensive data analysis, be sure to state your planned analysis methods as well. This includes the types of tests you'll perform and any programs or software you'll use for calculations (if relevant). Example: Procedures First, tomato seeds were sown in wooden flats containing soil about 2 cm below the surface. Each seed was kept 3-5 cm apart. The flats were covered to keep the soil moist until germination. The seedlings were removed and transplanted to pots 8 days later, with a maximum of 2 plants to a pot. Each pot was watered once a day to keep the soil moist. The nitrogen fertilizer treatment was applied to the plant pots 12 days after transplantation. The control group received no treatment, while the first experimental group received a low concentration, and the second experimental group received a high concentration. There were 5 pots in each group, and each plant pot was labelled to indicate the group the plants belonged to. 50 days after the start of the experiment, plant height was measured for all plants. A measuring tape was used to record the length of the plant from ground level to the top of the tallest leaf. Results In your results section, you should report the results of any statistical analysis procedures that you undertook. You should clearly state how the results of statistical tests support or refute your initial hypotheses. The main results to report include: Example: Results The mean heights of the plants in the control group, low nitrogen group, and high nitrogen groups were 20.3, 25.1, and 29.6 cm respectively. A one-way ANOVA was applied to calculate the effect of nitrogen fertilizer level on plant height. The results demonstrated statistically significant ($p = .03$) height differences between groups. Next, post-hoc tests were performed to assess the primary and secondary hypotheses. In support of the primary hypothesis, the high nitrogen group plants were significantly taller than the low nitrogen group and the control group plants. Similarly, the results supported the secondary hypothesis: the low nitrogen plants were taller than the control group plants. These results can be reported in the text or in tables and figures. Use text for highlighting a few key results, but present large sets of numbers in tables, or show relationships between variables with graphs. You should also include sample calculations in the Results section for complex experiments. For each sample calculation, provide a brief description of what it does and use clear symbols. Present your raw data in the Appendices section and refer to it to highlight any outliers or trends. Discussion The Discussion section will help demonstrate your understanding of the experimental process and your critical thinking skills. In this section, you can: Interpret your results Compare your findings with your expectations Identify any sources of experimental error Explain any unexpected results Suggest possible improvements for further studies Interpreting your results involves clarifying how your results help you answer your main research question. Report whether your results support your hypotheses. Did you measure what you sought out to measure? Were your analysis procedures appropriate for this type of data? Compare your findings with other research and explain any key differences in findings. Are your results in line with those from previous studies or your classmates' results? Why or why not? An effective Discussion section will also highlight the strengths and limitations of a study. Did you have high internal validity or reliability? How did you establish these aspects of your study? When describing limitations, use specific examples. For example, if random error contributed substantially to the measurements in your study, state the particular sources of error (e.g., imprecise apparatus) and explain ways to improve them. Example: Discussion The results support the hypothesis that nitrogen levels affect plant height, with increasing levels producing taller plants. These statistically significant results are taken together with previous research to support the importance of nitrogen as a nutrient for tomato plant growth. However, unlike previous studies, this study focused on plant height as an indicator of plant growth in the present experiment. Importantly, plant height may not always reflect plant health or fruit yield, so measuring other indicators would have strengthened the study findings. Another limitation of the study is the plant height measurement technique, as the measuring tape was not suitable for plants with extreme curvature. Future studies may focus on measuring plant height in different ways. The main strengths of this study were the controls for extraneous variables, such as pH and carbon levels of the soil. All other factors that could affect plant height were tightly controlled to isolate the effects of nitrogen levels, resulting in high internal validity for this study. Conclusion Your conclusion should be the final section of your lab report. Here, you'll summarize the findings of your experiment, with a brief overview of the strengths and limitations, and implications of your study for further research. Some lab reports may omit a Conclusion section because it overlaps with the Discussion section, but you should check with your instructor before doing so. Frequently asked questions about lab reports What is a lab report? A lab report conveys the aim, methods, results, and conclusions of a scientific experiment. Lab reports are commonly assigned in science, technology, engineering, and mathematics (STEM) fields. What's the difference between a lab report and a research paper? The purpose of a lab report is to demonstrate your understanding of the scientific method with a hands-on lab experiment. Course instructors will often provide you with an experimental design and procedure. Your task is to write up how you actually performed the experiment and evaluate the outcome. In contrast, a research paper requires you to independently develop an original argument. It involves more in-depth research and interpretation of sources and data. A lab report is usually shorter than a research paper. What are the sections of a lab report? The sections of a lab report can vary between scientific fields and course requirements, but it usually contains the following: Title: expresses the topic of your study Abstract: summarizes your research aims, methods, results, and conclusions Introduction: establishes the context needed to understand the topic Method: describes the materials and procedures used in the experiment Results: reports all descriptive and inferential statistical analyses Discussion: interprets and evaluates results and identifies limitations Conclusion: sums up the main findings of your experiment References: list of all sources cited using a specific style (e.g. APA) Appendices: contains lengthy materials, procedures, tables or figures

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