



# Indiana Academy of Science 2025 Science Talent Search



## Research Paper Guidelines

Submission due October 30 on website:

<https://indianaacademyofscience.org/register/science-talent-search-project-submission-page/?>



**RESEARCH PAPER.** The main goal of any scientific writing is effective communication – a hypothesis built by observation of a natural process, experimental design to test the hypothesis, a critical analysis of results obtained and a discussion which brings the research and ties it with current knowledge in the field of research. Follow rules and principles of writing a peer-reviewed article to be accepted and published in a journal.

### Sample paper:

#### I. **Organization of the paper**

- A. **Title.** The title of your paper should be a descriptive, concise statement representing the contents of the article. The title, “Electrolysis”, is too general. “The Electrolysis of Molten Sodium and Potassium Hydroxide to...” is better.  
Sample Title: INFLUENCE OF SULFONAMIDES ON GROWTH AND RESPIRATION IN BACTERIA
- B. **Introduction.** The purpose of the introduction is to make clear the subject of the paper. A brief paragraph should be sufficient. Indicate the purpose, scope, and method of the investigation. If the experiment tests a hypothesis, state the hypothesis and give the logic of its derivation. State the most significant result of the investigation, thus allowing the reader to judge the validity of your main conclusion in light of supporting evidence and inference. In the introduction, refer only to those literature citations that bear directly upon the introduction itself.
- C. **Methods.** Your method of investigation should be described in enough detail to permit the reader to repeat the experiment unless portions have been described in other reports which can be cited. Describe the design of the research, the logic of relating data to the theoretical propositions, the subjects, the sampling and control devices, the techniques of measurement, and the names of significant apparatus used. Such descriptions may include limitations of the accuracy of the equipment, details of experimental procedures, or mathematical arguments.
- D. **Results.** The purpose of this section is to present the appropriate data, thereby showing the relationships among the facts you have observed. When applicable, present the data in tables, graphs, and illustrations.
- E. **Discussion and Interpretation.** Pay particular attention to tests of statistical significance and to the logic of inference and generalization from empirical observations (inductive reasoning). Tell exactly what your experiments or mathematical calculations and data prove or disprove with respect to the problem originally defined. Support your conclusions by reference to the experimental results.

To prevent misunderstanding, define as clearly as possible the precise conditions to which your conclusions apply, and indicate the limitations of the conclusions in this last section of your paper. It is here that you might include a comparison of your results and interpretations with those of other investigators. Briefly discuss unexpected findings. State the implications of your findings for theory or practice.



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### Research Paper Guidelines (continued)



#### II. Writing the paper

- A. Before you start writing the rough draft of your paper, discuss your proposed idea with your teacher/sponsor/mentor. Then work closely at every stage of the process and discuss writing a rough draft and using their constant feedback write the final draft and get it approved by them.
- B. Good writing is able to convey the main message in the most concise, clear or easily understandable, complete and thoughtful way.
- C. Select materials carefully, including only what is necessary to allow a clear and accurate understanding of the main ideas, but omitting nothing that is essential. The scientist usually addresses a paper to specialists in a particular field, rather than to the general reader. However, a paper should be intelligible and usable by workers outside that narrow field.
- D. The primary purpose of your paper should be to give the reader valuable information and new ideas, so keep in mind what questions the reader will wish the article to answer.
- E. Use drawings, charts, diagrams, tables, and graphs to aid the reader's comprehension. Do not repeat in the text of your paper data presented in tables and graphs, only when you need to make an interrelationship. The text should concentrate on comparisons, relations, conclusions, and generalizations.

#### III. Common errors in logic

- A. Comparing results from experiments in which the experimental conditions were not identical.
- B. Failing to distinguish between fact and an opinion or inference.
- C. Drawing too broad a conclusion, drawing conclusions from faulty or insufficient evidence, and/or failing to recognize a conclusion.
- D. Confusing consecutive events with cause and effect.
- E. Being influenced by preconceived opinions and failing to admit evidence which implied an undesirable conclusion.
- F. Failing to define terms clearly and precisely.
- G. Begging the question: basing a conclusion on an unproved proposition, arguing in a circle, assuming the truth of an unproved proposition, or assuming that a proposition is false because you can disprove the supporting arguments.

#### IV. Revising the paper

- A. Examine the organization and consistency of the paragraphs and the sentences in your rough draft.
- B. Revise sentences and paragraphs with attention to clarity. There should be only one possible, easily understood meaning. Come directly to the point.
- C. Condense the paper, eliminating the obvious, repetitious, and idle words. Put yourself in the place of the reader.
- D. Correct the punctuation and the spelling! It is imperative that these be reviewed carefully.
- E. Your paper should be reviewed and approved by your teacher or sponsor before you type the final copy. Check the final copy for errors; correct where necessary.



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### Research Paper Guidelines (continued)



#### V. Style of writing

- A. **Tense.** Scientific papers are written primarily in the past tense. The references to previous research, the description of the study's procedure, and the statements of results should be stated in the past tense.

Examples:

Literature: "Langhorn's study found..."

Procedure: "A commercial feed was given to the chicks..."

Results: "The 50 ppm NaF was most effective in retarding..."

Only statements which have a continuing or general applicability should be written in the presence tense.

Theory: "Piaget's theory holds that..."

Presentation: "Diagrams of the dry yields indicate that...(Figure 3)."

- B. **Person and Voice.** Scientific reports usually are written in the third person. To gain objectivity, it may be helpful to write as though you are reporting the procedures and results of an experiment performed by another investigator.

Example: "The investigator divided the rats into groups..."

The passive voice is used extensively, particularly in describing procedures.

Example: The rats were deprived of water..."

- C. **Number.** Verbs must agree with their subjects, and pronouns with the nouns to which they refer. "Data," "criteria," and "phenomena" are plural words. "Criterion" and "phenomenon" are singular words. "Datum" is rarely used.



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### Research Paper Guidelines (continued)

#### VI. Supplements to the text

- A. **Acknowledgements.** Personal acknowledgements are usually not found in the body of a scientific paper. If necessary, acknowledgement may be made by a brief statement appearing in the “References and Acknowledgements” section (see VI-E-I).
- B. **Tables.** Good tabular presentation sets forth quantitative data systematically, precisely, and economically. A table should be a self-explanatory unit, and its form should facilitate comparisons within the table. Statistical data should be presented in highly condensed form.
1. Do not include columns of data that can be calculated from other columns.
  2. Every item in the table should be checked for correctness.
  3. Your tables should be numbered consecutively as they appear in your paper. Following is an example of the form in which a table should appear.

**Table 1.** Relationship between Seed Protein (amino acids) Content of Oats (cv. Rodney) with Growth and Yield the Following Generation<sup>1</sup>

Chemical	Rate (kg/ha)	<u>First Generation</u>		<u>Second generation</u>	
		Seed Weight (mg)	Total amino acids (mg/g; dry weight)	Seedling growth (mg/plant; fresh weight)	Seed yield kg/ha)
Control	0.00	29	103	187*	3830*
Simazine	0.07	29	132	267	5443
Simazine	0.28	30	131	282	4905
Terbacil	0.14	31	127	229	4736

\*F value for control compared to treatments is significant at the 0.05 level. The correlation of total amino acid content with seedling growth is significant at the 0.01 level ( $r=0.7106$ ) and with yield at the 0.05 level ( $r=0.7033$ ).

<sup>1</sup>Reprinted from Table 1 of Ries, S.K. and C.F. Schweizer, “Protein content of seed: increase improves growth and yield.” *Science*, 165(3888): 73(1969).

- C. **Illustrations.** Illustrations should make the presentation of scientific and technical matters more concise and effective. They quickly give the reader information which might require long verbal explanations and clarify objects or relations that are too complex to describe verbally. To reiterate, if your paper is illustrated suitably, your writing should consist mainly of comparison, inferences, and discussions or principles.
1. Each illustration should be a unit, presenting a single subject as clearly as possible.
  2. Use appropriate instruments for all diagrams and illustrations. Do not use freehand sketches.
  3. All figures, whether graphs or drawings or apparatus, should be designated as figures and numbered consecutively in Arabic numerals through the article. In the text, always refer to figures by their numbers and in this form: “(Figure 3)”, which may be inserted in an appropriate place in the sentence.
  4. All titles, captions, and descriptions must be word processed or typewritten.



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### Research Paper Guidelines (continued)

- D. **Graphs.** The purpose of a graph is to portray relations existing among data. Graphs should be clear, accurate, and pleasing to the eye.
1. Generally, the independent variable is plotted on the horizontal axis, and the dependent variable on the vertical axis.
  2. Scale of coordinates should be chosen so that the printed graph will be neither crowded nor wasteful of space.
  3. Both axes should be labeled clearly with both quantity measured and units in which it is measured. The legend is placed parallel to the proper axis.
  4. Lines should be inserted with instruments, e.g., ruler, French curve, etc.
  5. No more than four curves should appear on any given graph. Distinct geometric forms should be used to plot point, e.g., circles, triangles, etc.
- E. **Literature Citations.** Every reference cited in the paper should appear in a reference list at the end of the paper. List only relevant references. Books and journals, but not encyclopedias, are appropriate. Each entry in the references should be valuable to the reader.

Since the method of handling text references differs in the various scientific journals, the following method is suggested as one that is representative:

1. The list of books, pamphlets, and articles cited should be labeled "REFERENCES." if an acknowledgement is included, this list should be entitled "REFERENCES AND ACKNOWLEDGEMENT(S)" (see example below).
2. List the citations in alphabetical order by author's surname. Several reference to the same author are arranged by year of publication, the earliest first. The acknowledgement is the last item in this list.
3. In the text, place the author's surname and year of publication in parentheses at the end of the sentence or sentences which refer to materials by a particular author. Example "...in perception (Clear, 1963)."
4. Use the following form for references.

#### Journal

Druger, M. (1965). The use of *Drosophila* for high school projects in biology. American Biology Teacher, 27(7)539.

#### Book

Palmer, E.L, Smith, R.M., & Wood, B.J., Jr. (1957). Field book of Mammals. New York: E.P. Dutton & Co., Inc.

#### Acknowledgement (example)

The author is indebted to Michael Schmidt, graduate student in the Department of Microbiology, Indiana University-Bloomington, for helpful suggestions during this investigation.