

# Mastering the Abstract Writing Process

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# What Is an Abstract?

- A brief, written explanation of the research project, consisting of a succinct description of the project's purpose, the procedures followed, the data collected, and the conclusions reached.
- A clear and simple summary statement of the main points of the experiment
- A self-contained statement that must make sense all by itself.

# ISEF Abstract Rules

Intel ISEF rules require each Finalist to write an abstract of no more than 250 words to be displayed with the project.

An abstract gives the essence of the project in a brief but complete form to judges and the public viewing the Finalist's project.

Once approved, SRC provides the Finalist with two embossed copies of the abstract, one to display vertically at the project and the other to make copies to handout to judges and the public on visitors' day.

The abstract must focus on the current year's research and give only minimal reference to previous work.

Details and discussions should not be included in the abstract, but may be put in the longer, written research paper (if required), or given on the project exhibit board.

Finalists at the Intel ISEF are required to use the on-line system for submitting their abstract. Regional and local fairs use the **Official Abstract Form** (not necessary for most local fairs).

In addition, abstracts must not include acknowledgments (such as referencing mentor or university laboratory).

# Review of Abstract's Purpose

- Provides SRC a quick study of your project as it is an overview of the purpose, means, and result of research.
- Helps judges (both special and category) discern quickly whether the project qualifies for specific awards and whether the research is significant in its specific area.
- Informs visitors to ISEF (students, teachers, and the public at large) of the nature of the research.

# Steps in Developing Abstract

1. Begin with a *Research Project Prospectus* to outline the research project. A prospectus helps the researcher identify the nature and scope of the investigation, research methods, and anticipated conclusions and/or applications. An example of such a prospectus follows:

# Sample Research Project Prospectus

**Possible Title:**

**Name:**

**School:**

**Purpose of project / experiment**

*In a sentence of 25 words or fewer, explain the reason for your research project or a hypothesis you have selected to test.*

**Methods of research**

*Explain in a sentence or two how you plan to research your topic. What methods will you use? What resources will you need?*

**Data/Observations**

*Determine what data do you need to collect and what difficulties you may encounter as you research.*

**Conclusions/Applications**

*Explain in a sentence or two what results you anticipate your research will produce. What conclusions or applications do you hope to be able to explain?*

2. Once the research is completed and you are ready to show your project, use an Abstract Template to write a draft of the abstract. The following example was created using a table format in a Word document.

# Sample Abstract Template

Title Name School
Purpose of project / experiment: <ul style="list-style-type: none"><li>• An introductory statement of the reason for investigating the topic of the project.</li><li>• A statement of the problem or hypothesis being studied.</li></ul>
Summarize procedures, emphasizing the key points or steps: <ul style="list-style-type: none"><li>• A summarization of the key points and an overview of how the investigation was conducted.</li><li>• Omit details about the materials used unless it greatly influenced the procedure or had to be developed to do the investigation.</li><li>• An abstract should only include procedures done by the student. Work done by a mentor (such as surgical procedures) or work done prior to student involvement must not be included.</li></ul>
Detail succinctly observations/data/results: <ul style="list-style-type: none"><li>• This section should provide key results that lead directly to the conclusions you have drawn.</li><li>• It should not give too many details about the results nor include charts or graphs.</li></ul>
State conclusions/applications.

# Explanation of Parts

## **Purpose of the Experiment**

- An introductory statement of the reason for investigating the topic of the project.
- A statement of the problem or hypothesis being studied.

## **Procedures Used**

- A summarization of the key points and an overview of how the investigation was conducted.
- An abstract does not give details about the materials used unless it greatly influenced the procedure or had to be developed to do the investigation.
- An abstract should only include procedures done by the student. Work done by a mentor (such as surgical procedures) or work done prior to student involvement must not be included.

## **Observation/Data/Results**

- This section should provide key results that lead directly to the conclusions you have drawn.
- It should not give too many details about the results nor include tables or graphs.

## **Conclusions**

- Conclusions from the investigation should be described briefly.
- The summary paragraph should reflect on the process and possibly state some applications and extensions of the investigation.
- An abstract does not include a bibliography unless specifically required by your local fair. The Intel ISEF requires the bibliography as part of the research plan to be provided on Form 1A.

3. Revise and edit the abstract in the template. Once you have filled in each section, you can easily copy and paste the final version into the abstract form online. Such a procedure avoids the need to retype the entire abstract, thereby reducing the chance of errors in the final version.

# Sample Abstract

## Effects of Marine Engine Exhaust Water on Algae

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This project in its present form is the result of bioassay experimentation on the effects of two-cycle marine engine exhaust water on certain green algae. The initial idea was to determine the toxicity of outboard engine lubricant. Some success with lubricants eventually led to the formulation of "synthetic" exhaust water which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance.

Toxicity was determined by means of the standard bottle or "batch" bioassay technique. *Scenedesmus quadricauda* and *Ankistrodesmus* sp. were used as the test organisms. Toxicity was measured in terms of a decrease in the maximum standing crop. The effective concentration - 50% (EC 50) for *Scenedesmus quadricauda* was found to be 3.75% exhaust water; for *Ankistrodesmus* sp. 3.1% exhaust water using the bottle technique

Anomalies in growth curves raised the suspicion that evaporation was affecting the results; therefore, a flow-through system was improvised utilizing the characteristics of a device called a Biomonitor. Use of the Biomonitor lessened the influence of evaporation, and the EC 50 was found to be 1.4% exhaust water using *Ankistrodesmus* sp. as the test organism. Mixed populations of various algae gave an EC 50 of 1.28% exhaust water.

The contributions of this project are twofold. First, the toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature (1.4% vs. 4.2%). Secondly, the benefits of a flow-through bioassay technique utilizing the

Purpose

Methods

Data

Observations

Conclusions

Applications

# Other Examples

## **Persistent Global Activation of the *Aplysia* Serotonergic System After Sensitizing Stimuli**

The marine mollusk *Aplysia* responds to noxious stimulation with a stereotyped arousal reaction that includes escape locomotion, increased heart rate and sensitization of defensive reflexes. Although previous studies have shown that serotonin (5-HT) is important for most of these behavioral responses, it is still unclear how the 5-HT system is activated in response to noxious stimuli. To address this question, I used a specific staining of the 5-HT neurons in the living central nervous system (CNS) that allowed me to (1) systematically record their electrical activity following a noxious stimulus, and (2) trace their projections using the neuronal tracer Neurobiotin. I found that in response to tail-nerve shock, a procedure known to mimic a noxious tail stimulus, the vast majority of 5-HT neurons increased their firing rate for several minutes and became more excitable. 5-HT neurons were found to project toward various peripheral targets such as the gill, heart, body wall, tail, siphon, head, and tentacles as well as to other ganglia in the CNS. This study shows that the *Aplysia* 5-HT system is globally and persistently activated after a noxious stimulus. Such an activation might serve to synchronize the different aspects of the arousal reaction in *Aplysia*.

# Writing and Revising Tips

Simply put, the style of an abstract should always be declarative not discursive.

- Emphasize these aspects: purpose (hypothesis), methods, scope, results, conclusions, and recommendations
- Focus only on the current year's research when it is a continuation project.
- Exclude any of the mentor or supervisor's work
- Omit details and discussions
- Use the past tense to describe (*However, where appropriate use active verbs rather than passive verbs.*)
- Use short sentences, but vary sentence structure.
- Use complete sentences (*Do not abbreviate by omitting articles or other small words in order to save space.*)
- Avoid jargon
- Use appropriate scientific language
- Use concise syntax
- Use correct spelling, grammar, and punctuation

# Revision Techniques

- Addition – adding a word, phrase, or sentence

*Original: This project is an experimentation of the effects of two-cycle marine engine exhaust water on certain algae.*

*Revised: This project is a bioassay experimentation of the effects of two-cycle marine engine exhaust water on certain green algae.*

- Deletion – deleting a word, phrase, or sentence

*Original: The researcher has developed an original code required for successful implementation of the environment reconstruction application.*

*Revised: The researcher **developed** an original code required for successful implementation of the environment reconstruction application.*

- **Substitution – substituting one word, phrase, or sentence for another**

*Original: In the beginning, the idea was to determine the toxicity of outboard engine lubricant.*

*Revised: The **initial** idea was to determine the toxicity of outboard engine lubricant.*

- **Transposition – moving words, phrases, or sentences to another position**

*Original: Using optical fibers as light guides, a system was created with light guided from a light source to an integrating chamber, reflected and guided back to a digital camera.*

*Revised: A system **using optical fibers as light guides** was created with light guided from a light source to an integrating chamber, reflected, and then guided back to a digital camera.*

- **Combination** – combining sentences and/or paragraphs, which usually results in the use of multiple revision techniques and a considerable shortening of the passage.

*Original: The project was started with an investigation of methods in use today and possible alternatives. Two alternative methods that seemed to be promising were chosen — the first method is to kill bacteria with pulsing high voltage, and the second is boiling with high efficient heat exchanging.*

*Revised: The project **investigated** two alternative methods in use today: **1) killing** bacteria with pulsing high voltage; **2) boiling bacteria with a high efficient heat exchange.***

# Quiz: What techniques are used in revising this passage?

## Original:

- **The purpose of my project** is to find the connection between the ratio of radii of an ellipse and **its** mechanical advantage on specified angle of rotation intervals.

## Revision:

- This project examined the connection between the ratio of radii of an ellipse and the mechanical advantage of a specified angle of rotation intervals.

## **PERIOD ANALYSIS OF CATAclySMIC VARIABLE X10 AND ITS IMPLICATIONS ON THE ORIGIN OF LOW STATES**

Cataclysmic variables are binary systems, each consisting of a white dwarf (the primary) and a low mass star (the secondary). Usually, matter flows from the secondary onto the primary, producing X-rays upon impact. However, previous observations have indicated that certain cataclysmic variables frequently exhibit low states – a dramatic decrease in mass transfer (and thus X-ray production) for an extended period of time. Low states can last up to several years, and this phenomenon is currently not well understood. This research is primarily focused on creating a model to elucidate the origin of low states using data gathered from X10, a magnetic cataclysmic variable that experienced a low state in year 2005. The model proposed in this study attributes low states to the magnetic interactions between the secondary's starspots and the primary, and its predictions on which systems should exhibit low states and which ones should not have all been confirmed by past observations.

## THE STRING TOPOLOGY BV ALGEBRA, HOCHSCHILD COHOMOLOGY AND THE GOLDMAN BRACKET ON SURFACES

This project provides an algebraic description of the String Topology Batalin-Vilkovisky algebra for a large class of manifolds. Such a description previously existed only for spheres and projective spaces.

The homology  $H(LX)$  of the space of free loops of a closed oriented smooth manifold  $X$  has a rich algebraic structure called string topology, discovered by Chas and Sullivan in 1999. In particular,  $H(LX)$  is a Batalin-Vilkovisky (BV) algebra. However this structure is hard to compute in algebraic terms.

This project studies string topology in the case when the manifold  $X$  is aspherical. In this case the Hochschild cohomology Gerstenhaber algebra  $HH(A)$  of the group algebra  $A$  of the fundamental group of  $X$  has a BV structure. My main result is a theorem establishing a natural isomorphism between the Hochschild cohomology BV algebra  $HH(A)$  and the string topology BV algebra  $H(LX)$ . In particular, for a closed oriented surface  $X$  of hyperbolic type this gives a complete description of the BV algebra operations on  $H(LX)$  and  $HH(A)$  terms of the Goldman bracket of loops on  $X$ .

There are several conjectures connecting the string topology BV algebra with algebraic structures on the Hochschild cohomology of algebras related to the manifold  $X$ . My theorem is the first such hypothesis that has been proven. The proof is based on a combination of topological and algebraic constructions allowing to compute and compare multiplications and BV operators on both  $H(LX)$  and  $HH(A)$ .

## COMPUTER AIDED INSTRUCTION IN THE MODERN CLASSROOM

Computers have benefited mankind in many areas, and are still left untapped in many areas. The main aim of this project was to provide a modern, fresh and exciting environment for education to take place in - utilizing computers as a medium. Although not restricted to, one of the concerns and motivations of this project was to make this new form of education accessible to the underprivileged, both in South Africa and internationally.

A program suite was designed to enhance education in the classroom. VirtuaLAB, a Virtual Reality (VR) laboratory, provides a 3-Dimensional, fully equipped and extensible science laboratory where the students have the freedom to conduct experiments, learn and experience chemistry 'first hand' (similar to modern video games), all provided through an affordable desktop solution. Testing, both of the students' and teachers' usage of the program, as well as research into the affordability and viability of such a proposed environment was also conducted.

There are many communities where overpopulation, poverty and lack of resources have made education inaccessible. VirtuaLAB was investigated to determine how it could aid such a community practically. Other benefits, such as those to student's progress, results and attitude towards their education, were examined.

In the broader perspective, VirtuaLAB is one implementation of a Computer Aided Instruction (CAI) environment – using VR to immerse the user in the VirtuaLAB world. The community response alone proved that such new technologies are not only viable but are also demanded and that endless opportunity waits in this modern technological future.