YCISL STEP-UP SCIENCE FAIR SERIES

RfP

DESIGN THINKING YOUR SCIENCE FAIR RESEARCH PROPOSAL

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YCISL Step-Up Science Fair Series: RfP. Design Thinking Your Science Fair Research Proposal

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Content

Preface

Great research starts with successful research proposals. This success arises from scholarly thinking mixed with persuasive writing, & framed with interesting connectivity to our existing knowledge, expertise & curiosity. This e-book focuses on the young science fair student who has to submit a proposal for their project, & highlights key points that make for better proposals. Better proposals mean better planning, better chances of success, & better life-changing experiences.

Since originality is a universally necessary element of research, the creativity focus of the YCISL program that I created at Stanford University is applied in this e-book. Uncertainty is addressed with rapid prototyping. Ideation is facilitated through divergent-convergent thinking. And success is largely determined by taking an idea through a step-wise process to realization. This is the essence of the YCISL Simple Innovation Framework – now applied to science & engineering research.

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If you have noticed by reading my other e-books, I need new environments to get in a productive writing mind. Unable to get far away this time, I chose to visit a local city library that I had not been to before. My senses are stimulated here. Comfortable air & workspaces. Spacious views inside & through the windows. Just enough sounds (I think there is a children storytelling time going on downstairs) to periodically lose attention & push-pull my creativity in a good way. I like libraries.

Read Me

Read Me

The content presented in *RFP* is written with my Synopsys Championship SRC reviewer mindset. I truly believe that science fair students can advantageously apply this insight to their research proposals so long as they empathize with the reviewer. The reviewer is a reader. A reader who will react, respond & perhaps even comment. The reviewer & proposal authors are on a team with the common interest of getting the green light.

A Request for Proposals

“RFP” is short for *Request for Proposals*. An RFP is usually an announcement that an organization wishes to receive proposals for an activity. For a science fair, the RFP provides guidelines for student participants to submit a research plan that would be assessed for feasibility & rules compliance. The RFP must be read carefully. Very carefully. This careful reading is part of the skills learning in becoming a researcher. Become very mindful of the RFP.

How Design Thinking Fits In

Science Fair research involves the engagement of many people. If you were asked to list who is involved, how many could you name? Yourself as researchers. The judges. Your teacher. Also remember parents, mentors and the people your research is intended to benefit. Design Thinking uses human-centered focus to consider this engagement within a high emotional intelligence framework so that the details, promise and ask are perfectly clear and compelling.

Mindset & Empathy

Science Fair research has the premise of developing the growth mindset of the researcher. The ability to explore new things. In the research proposal, empathy is essential. Self-empathy so the plan is achievable with all the constraints of skill, resources and time. Empathy for your teacher and the SRC reviewer who need to be able to fully understand the work, especially safety, in order to grant approval. An appreciation of mindset and empathy raises the ownership and focus level.

Project Title

One of the first things that I see in the project list view that motivates me to review a proposal is its title. The project title should be both concise and precise. Throughout the review, I have the title in mind as I make sure that it accurately reflects the research. Revisit the project title whenever the project proposal has been modified. Sometimes, I will suggest that the student or team iterate the title for improving the grab & focus.

Project Type, Category & Field

There are two Project Types in a Science Fair: Science, & Engineering. A science project explores & discovers new science. An engineering project focuses on the design & build of something functional based on science or existing engineering. The category and field should reflect where the innovation contribution to research predominantly lies. Which audience would be interested in the research? One clue may be the journal name of your primary literature reference used to justify your project.

Rationale & Justification

The research plan rubric requires a Rationale which justifies the project work. This statement should provide support for the idea as well as approach. This is also a good place for the originality and conceptual understanding to be shown.

Feasibility

The feasibility of a Science Fair proposal is established by a supported idea rationale as well as the reviewer's belief that the researcher has the skills & training to perform, analyze, & interpret the work. A lack of detail usually will have doubtful feasibility. A barebones Materials list, Methods section, or Bibliography are usually the immediate giveaways that a project is not feasible. The reviewer needs to be persuaded of project feasibility.

Due Diligence, Safety & Risk

Perhaps the most critical of SRC reviewer tasks is to ensure that the proposal has undertaken necessary due diligence, and that safety has been fully considered. This includes risk assessment and documented compliance. Location of hazardous research work should be noted especially if outside a research lab. Qualified supervisors are required for work with hazards & risks. Waste disposal & permits are two frequent attention areas.

Documentation: Methods & Materials

Quality documentation is a great skill to encourage in these young research students. Ask for detailed methods, material lists, & test protocols that demonstrate end-to-end planning as well as assist your visualization of the set-up, work & clean-up. Clear and complete documentation in a proposal is also useful to students for traceability & reproducibility.

Bibliography

The bibliography reflects on the scholarly nature of the proposal. Students should appreciate that a bibliography gives due credit to authors of past work & connects ideas in the proposal to the existing research knowledge domain. References should be from high quality sources, and cited using a standard style (eg, MLA, APA or from a research journal). Citation deficiencies may constitute plagiarism or a research ethics violation.

Illustrations

Illustrations usually help the reviewer better understand a research proposal. Drawings or sketches should clearly convey form (size, shape), function & operation. Flowcharts are especially useful where logic or decisions are involved. Maps or photos can also provide useful detail. For science projects, apparatus drawings may help. Project Design Criteria and Constraints could be show in sketches for engineering projects. Think about visualization clarity.

Minimum Quality Requirements

A research proposal should meet the Minimum Quality Requirements. This is a universal necessity in any kind of proposal writing. Failing any such requirements makes the project a non-starter. Fortunately, for a science fair, there is usually a chance to take corrective action & re-submit a revised proposal. Each component of these requirements should be lucidly presented & ambiguity-free. While minimal in content, these requirements should be met with utmost attention to detail & empathy.

Forms, Dates & Check-Marks

For a SRC review, there is substantial busy work in making sure the required forms are present & correctly filled in. Sometimes, project titles on the application form (& database) do not match the proposal title. Additional forms may be needed depending on the review's assessment. And forms need to have dates changed, signatures added, and boxes checked or un-checked. This aspect really has to be in perfect shape for a project to be accepted.

Compliance Rules

A Science Fair research plan needs to be in compliance with rules regarding safety and regulation. There are Hazardous Chemicals, Activities & Devices rules. There are Hazardous Biological Substances rules. There are Human Participants rules. There are Animal Subject rules. Most of the rules involve design thinking in that they anticipate the impact of the research on humans, and require that risks& hazards be reduced or eliminated without compromising the research.

Approval

A reviewer will approve a Science Fair research proposal with an Accepted status if it meets quality, content, compliance, documentation, & safety due diligence requirements. A proposal may be given Incomplete status before approval to indicate that changes or responses from the researchers are needed. A proposal may be in Pending status if the proposal is in review, or there is a matter about the proposal that needs to be discussed with the SRC committee.

Top 10 Most Frequent Review Comments

#1

“Provide materials list. Each item should contain enough detail so that I could look it up.”

The most surprising gap found in a proposal is when a materials list is missing. Similarly, a materials list with missing items or generic names will be called out in a review. A complete & detailed materials list is one of the components needed to meet the Minimum Quality Requirements.

#2

“For the Risk Assessment form, please specify the exact chemicals that will be used.”

Students should learn & practice safety due diligence as part of their research training. Often, risks & hazards are neglected, & a risk assessment becomes one of the required actions after SRC review.

#3

“For greater traceability of the chemicals in your Materials list, please also include source, form/state of matter, and other distinguishing information for each item.”

For research quality assurance, specialty materials & equipment should be listed with specific & distinctive detail. Traceability allows greater confidence, accuracy & precision in data & observations interpretation.

#4

“Is temperature important in this experiment?”

Environmental conditions may affect the results of experimental work or performance tests. In the research proposal, note all conditions that may affect the outcomes, & should be monitored for change & variability…or kept constant. Awareness of such factors show a research level of thorough attention to detail.

#5

“Reference 7 is not a usable reference because it does not give any peer-reviewed information.”

Bibliography references reflect on the quality of the research idea & proposal. Associate your proposal with reliable sources of information including peer-reviewed articles & publications written by scientists & engineers at well-known research institutions. Start with the top ranked journal in your research area.

#6

“Provide Test protocol in the format of numbered step-wise instructions.”

Engineering test protocols should match the design constraints & criteria that are stated in the proposal. The protocols should be structured, easy-to-follow & un-ambiguous so that any person could conduct the performance tests & measurements. The test results should be binary as pass or fail.

#7

“Include power requirements. Specify AC or DC, voltages, and wattages.”

Where electrical power is part of an engineering design, the power requirements should be specified. Use of GFCI outlets and other mitigating electrical safety measures should be included in the proposal where human risk is a factor. Only household batteries (AAA, AA, C, D & 9V) are considered low-risk.

#8

“Please describe the test area. I am especially interested in how you will get up 4 m high (safety concern).”

The reviewer should be able to spatially visualize an experimental or test area in order to anticipate safety issues. Sketches, layout diagrams or maps may be illuminating. Applies to both indoor & outdoor spaces.

#9

“Provide Rationale for project. Use bibliography references to support your rationale.”

A good project rationale shows how the proposed research would expand the knowledge domain, fill gaps or advance understanding in an opportune & timely way. The *raison d'être* (justification) should be competitively compelling & persuasively feasible.

#10

“The research plan does not satisfy the Engineering Project Minimum Quality Requirements. Insufficient information. Needs detailed explanation of rationale, fabrication, functionality, operation and testing.”

To satisfy the Minimum Quality Requirements, a proposal needs enough detail for another researcher to do the *same* work & get the *same* results.

If you reached this point...

I hope this brief shared reflection on my own reviewer experience will be helpful to student proposal authors…and maybe even other reviewers. By highlighting these aspects, proposal quality can be raised and we can all be happier with both the writing & reviewing experiences. As a reviewer, I applaud student enthusiasm for research while having the opportunity to elevate a student's propensity for quality research.

RfP: Design Thinking
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Are you a science fair student new to proposal writing? Or did you just volunteer to review science fair proposals to become more engaged in youth education? Look inside for personal insights into the review of science fair proposals. Learn how students can craft, iterate & polish their research proposals so that they reflect scholarly curiosity & enquiry. It's not so hard when you know what details to care about in presenting a good idea & proposition.