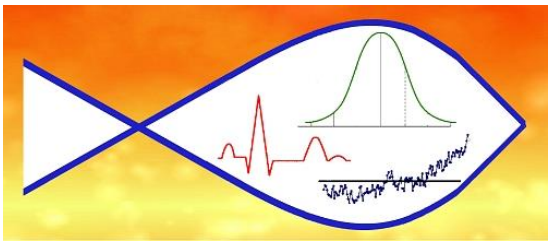
Exploring Science and Faith: Guidelines for High School Student Participants



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What is the context and purpose of this science fair?

The "exploring science and faith" themed science fair is an opportunity for high school students from local Christian schools and homeschools to enter their science/math research projects into a regional fair. The science fair is sponsored by the Elder Exchange, an academic forum organized and maintained by retired scientists and educators living at Virginia Mennonite Retirement Community (VMRC). Further information about this project may be obtained by visiting our website: https://RichardLBowman.com/EE/scifair/ or sending an email: elderexchange@gmail.com

As Christian students use the tools of science – investigation, discovery, communication – do they simultaneously see the "fingerprints of the Creator" at work in the world both in the past and present? A primary goal of this science fair is to encourage high school students, who explore an aspect of science through the completion of a research project, to recognize and describe the integration of faith within their work.

In our Christian understanding, we believe God originated the world and the elements within it and that God continues to sustain the universe. This raises questions about God's character, his past actions and design, and consequently how Christian scientists should do their work today. Students will pursue these and other such questions in their science and faith research projects.

What are the key elements?

Two phases make up the student projects for this science fair: **Project Research Paper** (PRP) and **Project Poster Display** (PPD). The first phase, the Project Research Paper, describes a student scientific project including its experimental design, data or results, and conclusions. Any high school student, who has completed a science research project and has the approval of a teacher/mentor, is invited to submit a PRP. (The Entry Form, found in page 8, must be filled out and submitted with the PRP.) The format of the PRP must follow specific guidelines described later in this document. When completed, the PRP must be submitted on or before March 11, 2020, for evaluation by a team of reading judges. The reading judges' evaluation (commendations and critiques) will be returned to the student and the teacher/mentor. (The Reading Judge Evaluation Form can be found on page 9.) Based on the judges' recommendations, selected projects will be invited to enter the Project Poster Display event.

The second phase, Project Poster Display, will include up to 40 student project presenters, who are invited to bring their projects to the science fair located at Virginia Mennonite Retirement Community's Detwiler Auditorium on Thursday afternoon/evening, April 16, 2020. During that afternoon, a team of judges will visit each project display in the presence of the student presenter. The student will explain the overall project and findings to the judging team and then respond to their questions. (See page 10 for the Science Fair Judge Evaluation Form.) Certificates and prizes will be awarded to participants during the Project Poster Display event.

The following four project categories are identified for the student research projects:

- **CPE:** Chemistry, Physics, Physical & Earth Science
- **BEA**: Biology, Environmental Science, Agriculture
- **BMP:** Biomedicine, Health, Psychology
- **CME**: Computer Science, Mathematics, Engineering

Student projects will be entered in one of these categories. While many projects may involve multiple aspects, e.g. both biology and mathematics, the student researcher should choose the single category that provides the best overall description of the project field. Judging teams will be selected for each category. Typically, a judging team of three persons will read and evaluate each PRP and PDP. Different persons may be involved in evaluating the PRP versus the PDP. Judging teams will be made up of residents from VMRC, community science professionals, educators, and some upper level college or graduate students. Judges will evaluate projects based on the following criteria:

- scientific thought and understanding (40%);
- creativity, originality & logical structure (20%);
- integration with faith & scripture (20%);
- written, visual, and oral communication (20%)

Why Do A Science Research Project?

A quality science research project involves a major commitment of time and energy. For a student with an inquiring mind who enjoys science, a research project provides the opportunity to explore an unresolved question or problem and make a novel discovery. Many students read about science and learn a lot of scientific information that is based upon research others have done. However, "reading about science" is significantly different from "doing science." A student scientific research project is an example of doing science.

What motives a student to do a science research project? In some cases, the motivation might be to earn a good grade if a teacher requires the research project as part of completing a science course. Other values – curiosity, perspectives, and having fun -- may provide motivation to do a science project. John Locke once said, "curiosity … is but an appetite for knowledge." Curiosity motivates learning and frequently becomes the driving force in leading one to use the processes of science to answer a specific question that has not yet been answered: Why? How? What is the relationship? How much or many? Questions like these often precede the planning of a science project. Dr. Seuss, the notable author of many children's books, wrote, "It's not about what it is, it's about what it can become." Similarly, the outcome of a research project frequently leads the investigator into previously unexplored fields that bring a new understanding or a new way of thinking about a specific problem or issue. Consequently, a new scientific understanding may emerge that is informed by experimental data. Finally, doing a science project is one example of "having fun" and frequently very constructive fun. Play may well be the highest form of research! Discovering new relationships or information about the natural world brings personal satisfaction to the explorer.

What is involved in a science research project? Generally, a research project is originated by identifying a specific question. The initial response to that question involves investigating published scientific literature. Has this question been investigated before? What information is needed to plan a project that is designed to answer the question? What methods are most applicable to answer the question? Following the selection of specific methods, an experimental design is conducted to acquire information or data that may answer the experimental question. Typically, the obtained data or results are quantified and statistically analyzed. By applying the summarized results to the experimental question, answers can be posed to the experimental question, forming data-based conclusions. However, this is not the end of doing science. Another essential step is informing the broader community about the project. Unless the results of a scientific experiment are published within a science community, the project is simply a hobby, rather than "doing science." Publication, following the review and critique of other scientists, validates the study project and contributes to the informational pool of science. Publicizing the entire project for the broader community fulfills the methodology of "doing science."

How does "Exploring Science and Faith" relate to a student research project?

A key scripture passage provides foundation for our thinking: "The earth is the Lord's, and everything in it, the world, and all who live in it; for he founded it on the seas and established it on the waters" (Ps 24:1-2, NIV). Implicit in this passage is that the ownership of earth and its fullness belong to the Creator Lord who originated and established it. When we study the things in the earth with the tools of science, we are examining and seeking to understand the structure and function of objects and systems that God originated and owns. A novel discovery or a new scientific model should remind us of the majesty and complexity of God's created order. One aspect of doing a science project for a Christian is to recognize that the complexity and workings of nature and the material things of the earth are a consequence of the creative acts of God – rather than simply "accidents of nature".

We do science for a purpose. Seeing how the outcome or application of a specific project relates to a biblical theme or principle is another way of understanding the connection between science and faith. Practical scientific findings have a great potential for doing good for humans, the earth, and the environment and have the potential as well for causing harm and evil. Thus ethics – how we ought to behave – is frequently a science and faith connection. The Creator has blessed humankind with vast resources. How we creatively use those resources for the good of the world reflects our commitment to Christian stewardship—another realm of connecting faith to science. The American Scientific Affiliation website (https://www.asa3.org/ASA/education/views/stewardship.htm) declares, "For a devoted Christian, stewardship of life should include everything in life, in all of the many opportunities provided by God, who gives us time, abilities, knowledge, money, and relationships, plus the earth's environment and natural resources, and more." In so doing, we bring glory to the Creator who not only originated us but also sustains us. These few thoughts on the relationship between Christian science and faith are designed to stimulate your thinking. As a student scientific researcher, we hope you can demonstrate connection between your science project and your Christian faith.

How should a research project be conducted?

As you begin, consider the ethics of doing and writing about a research project. The work that you present must be your own work and not copied from the work or project of another person. Plagiarism occurs when you assume credit for another's work. In researching background literature related to the topic of your project, you will find a lot of information which you will want to incorporate into the various sections of your research paper. Care must be taken to properly credit derived information. Cite original sources. A very helpful internet resource to check for plagiarism in a written report is the free service offered by Quetet.com. Check out their website located here: https://www.quetext.com/ After signing up, a portion or the entirety of a paper can be uploaded to check for plagiarism.

Some projects may have multiple authors, who team together to research and complete the work. In that case each involved person should be listed as an author or investigator. Whether single or together, you must have a mentor or teacher approve the project. The name and contact information of your mentor will be listed on the entry form. You should discuss your research idea with your mentor to receive needed guidance as you progress through the experimental and writing phases of your research.

A research project that is formed at the "last minute" will not be successful. You need to plan early if you want to carry out a successful project. Often the most difficult part is to identify the experimental question that you want to explore. When that is done you need to consider what methods can be used to answer the experimental question. Creating a project design that contains both controls and experimental groups measured by appropriate variables are essential to success. Think ahead to how you might quantify your data as well as what statistical tests you can use to help verify experimental results. When selecting specific methods, attempt to use simple approaches with readily available materials. Be creative and logical.

Create a research notebook to organize and categorize your project. The research notebook can contain copies of pertinent background literature that provide the context for your project. Write out the steps of your methods; write down the datum points that you obtain with your experimentation. A log of the time spent on your project and details relating to the problems encountered when running experiments can be helpful. Drafts of your research paper can be kept in the notebook for reference. In short, your research notebook is the central location where information about your project can be organized and stored. It will be a valuable tool for ongoing reference and is far superior to keeping project information on separate slips of paper that get scattered and lost.

What are the essential sections of the Project Research Paper (PRP)?

Each paper must contain the following seven sections: Title Page (Student Entry Form, Page 8), Abstract, Introduction, Methods & Materials, Results, Discussion, and Literature Cited. The **Title Page** form can be downloaded as a Word document from the Science Fair website. Replace the blanks with typewritten text responses and format the document as Page 1 of your PRP.

The **Abstract**, typically written last, appears immediately following the Title Page. The Abstract should not exceed one page (350 words) and should succinctly describe the project rationale, the experimental question, essential methods used, primary results, and conclusions. No references should be cited in the Abstract.

The **Introduction** should give the background or context to the project by summarizing the currently available published literature applicable to the project's topic. Near the end of the Introduction, the specific experimental question should be clearly stated.

The **Methods and Materials** section provides the place to describe the project design as well as the planned tools or methods needed to obtain project data. Primary material items used in the project should be described within the method description and not itemized as a separate list.

The **Results** section localizes the data or results obtained. In most science projects the data represent numerical quantities derived from running experiments. Typically, the experimental data are summarized as groups in the results section rather than by listing individual datum points. Thus, it is much more appropriate to list measures of central tendency (e.g. means or averages) and measures of dispersion (e.g. range, standard deviation) of the data in the results rather than the individual datum values. Indicating the number of datum points that are summarized in a mean is an important value. Statistics should be used to compare control values with experimental values. While the data should always be summarized in the text of the paper, a visual representation of the data greatly enhances understanding the project. Such visual representation may include photographs, diagrams, summary tables, graphs, etc. Each visual representation, i.e. graph or diagram, should be numbered and titled (e.g. Figure 1. Body Weights and Heights.) and referenced in the text. The figures should be located near the portion of the text where the specific results are revealed.

Discussion is the section where the data or results are explained and applied to the experimental question. Typically, it is the place where the results of other experimenters are compared with your results. This is also the place where final conclusions are made.

Literature Cited section should include only those sources that are cited in the paper. Typically, you will have read much more background material than what you cite in the paper. For high school students a good literature cited section will include a minimum of five peer reviewed or scholarly sources as well as numerous other references that may be classified as non-scholarly sources, such as many website sources, popular publications, and magazine articles.

How should the PRP be formatted?

The length of the PRP should range between 1500-3000 text words, excluding the Title Page and the Literature Cited pages. Overall after the diagrams, figures, and illustrations are incorporated into the paper, the PRP must not exceed 12 pages, excluding the Title Page but including the Literature Cited page.

The paper should be written in 12-point font (Arial, Helvetic, Times New Roman are preferred) with single line spacing within paragraphs. Paragraphs should be separated by one blank line. Additional requirements include one-inch margins with headers and footers, simple pagination centered on the footer and an abbreviated title with author last name(s) on the page header.

The form of literature citation used must be the Council of Science Editors, **CSE Name-Year system**. Numerous websites provide information about this citation system. Following are two recommended sites: (1) McGill University website has a 4-page PDF document that can be downloaded and printed for reference. https://www.mcgill.ca/library/files/library/cse-name-year-citation-style-guide.pdf (2) Austin Community College library has a good website that provides a lot of information. https://library.austincc.edu/help/CSE/CSE-ny.php

What is the procedure of the Project Poster Display (PPD) event?

Following the judging phase of the Project Research Paper (PRP), reading judges will recommend up to 40 projects for inclusion in the Project Poster Display event that is scheduled for April 16, 2020. All students will be notified regarding the judging outcome of their PRP's on or before March 28, 2020.

In preparing the science project for the PPD event, we recommend that a large tri-fold self-standing poster board (corrugated or foam) be purchased to mount and display the essential elements of the PRP. Each project will have a minimum of 48"x 30" available table space. (Poster boards are available from Walmart or Staples at a very minimal cost.) In creating a display poster, make certain that the lettering is large enough so that it can be read at a short distance. For guidelines in creating an effective poster display, the Science Buddies website gives some great directives: https://www.sciencebuddies.org/blog/top-ten-tips-project-display-board

PPD Schedule for April 16, 2020. (Auditorium is closed to the public from 1:30 – 5:30 p.m.)

- 1:30 – 3:00 p.m. Student presenters arrive at Detwiler Auditorium, complete a simple registration form, pay the registration fee ($10 – cash or check) and set up PPD.
- 2:30 – 4:30 p.m. Judging Teams visit individual PPD spending about 15 minutes with each project. The student presenter takes 8 minutes to explain essential project ideas, which will be followed by a question and answer session with the judges. (After judging is completed for a given project, the student presenter is free to leave until 5:00 p.m.)
- 5:00 – 5:30 p.m. Light Supper is served in Detwiler Auditorium for student presenters. Certificates and prizes are awarded. Participation, Honorable Mention, 3rd, 2nd, 1st place award certifications will be given in each of the four categories. Money prizes will also be awarded: (1st=$50; 2nd = $25; 3rd = $15). First place prize winners will present their projects to the Elder Exchange meeting beginning at 6:30 p.m.
- 5:30 – 6:30 p.m. Project Displays (except the four 1st place winners) will be open to public viewers. Presenters are requested to stand by their project displays and informally describe project to interested observers. (First place winners will move their projects to display tables on the stage area in preparation for the Elder Exchange meeting.)
- 6:30 – 8:00 p.m. Elder Exchange Meeting. 1st place winners will each explain their project (10 min) to the assembled group and then respond to audience questions (5-7 min)
- 8:00 – 8:30 p.m. Projects Displays taken down by student presenters.

EE Science Fair – 2020 Entry Form & Title Page

"Exploring Science and Faith"

Directions: *Download this digital form (Word document format) and fill in the blanks with typewritten text. Type affirmation signatures at the bottom, making certain that your sponsor (teacher) has read the form and approves of the information. This page must be submitted as the Title Page of the Project Research Paper, which is due to be uploaded on or before 3/11/2020 on the Elder Exchange Science Fair website. For multiple authors on a single project paper, each person must fill out this form.*

A. Student Name: (Last, First) _____

Mailing Address: _____

Student Email: _____ Student Phone: _____

Parent Name: _____ Parent Email: _____

B. School Name: _____

School Address: _____

School Phone: _____ School Email: _____

C. Name of Teacher/Sponsor: _____

Sponsor Phone: _____ Sponsor Email: _____

D. Title of Project Research Paper: _____

_____

If multiple author paper, list other author name(s): _____

_____

Project Code: Category	**Check Main Category**
A. CPE: Chemistry, Physics, Physical & Earth Science	
B. BEA: Biology, Environmental Science, Agriculture	
C. BMP: Biomedicine, Health, Psychology	
D. CME: Computer Science, Mathematics, Engineering	

Major H.S. course(s) supporting project: _____

Student Class Grade in School: ____

E. Participant Affirmation: This project paper has been reviewed by my sponsor and reflects work that I have done. If my paper is accepted, I agree to present my project in the Elder Exchange Science and faith Fair at VMRC on April 16, 2020. I also agree to accept judges' decisions and give permission to be photographed or filmed while participating in the Science Fair.

Student Signature: _____ Date: _____

Sponsor Signature: _____ Date: _____

EE Science Fair – Reading Judge Evaluation Form

"Exploring Science and Faith" Judge's Evaluation Due: March 25, 2020

Paper Category: (CPE, BEA, BMP, CME) School **Name:** _____

A. Student Name: (Last, First) _____

B. Title of Project Research Paper: _____

Criteria – Characteristics of an outstanding project paper	Score	Judge Comments to student
Scientific thought and understanding (40%) • Paper elements are all present: Title page, Abstract, Introduction, Methods & Materials, Results, Discussion, Literature Cited with minimum of 8 quality references; Background research provides clear context for project **(20 pts) *** • Clear statement of problem or question investigated; experimental design relates to project question; variables and controls are identified; data correspond with scientific question; data are summarized and analyzed; consistent conclusions formed **(20 pts) ***		
Creativity, originality & logical structure (20%) Project stems from a unique idea; work completed by student with minimal mentorship; shows clarity of purpose and depth of content; illustrative figures or photos are also described in the text; literature cited connects to project design and experimental results **(20 pts) ***		
Integration with faith & scripture (20%) • A biblical theme or passage is identified **(10 pts) **** • Faith theme explained and applied in the project's experimental design or intended outcome **(10 pts) ****		
Written communication (20%) • Appropriate length (6-12 pages or 1500-3000 words, excluding Literature cited); Correct paper format (12 point font, Arial, Helvetic, or Times New Roman) with single line spacing, 1 line between paragraphs; 1 inch margins; pagination centered on footer, author last name and abbreviated title on header; CSE Name-Year system used in citations. **(10 pts) **** • Paper is well written, concise, eloquent and rhetorically effective; logical paragraph structure; is engaging throughout and enjoyable to read with good grammar and sentence structure; excellent word choices **(10 pts) ****		
Total Score =		

*Score range (20 points): Excellent (18-20), Good (14-17); Average (10-13), Below Average (≤9)

**Score range (10 points): Excellent (9-10); Good (7-8); Average (5-6), Below Average (≤4)

Judge's Summary Comments/Suggestions:

Reading Judge Name: _____Completion Date: _____

EE Science Fair – Science Fair Judge Evaluation Form

"Exploring Science and Faith" April 16, 2020

Paper Category: (CPE, BEA, BMP, CME) **School Name:** _____

Student Name: (Last, First) _____

Title of Project Research Paper: _____

Criteria – Characteristics of an outstanding project presentation	**Score**
Scientific Thought and understanding (40 pts) * • Presenter understands and clearly explains rationale for selection of the investigated problem/question • Clearly defines the problem or question investigated; experimental design relates to project question; identifies variables and controls; explains how data correspond with scientific question; summarizes and provides analysis for data; develops consistent conclusions • Identifies problems/shortcomings with the research project and potential solutions • Represents a project with high quality	
Creativity, originality & logical structure (20 pts) ** • Logically responds to questions with relevant information • Demonstrates innovation in project conception, completion, and analysis • Demonstrates understanding and familiarity with experimental methods • Explains the role of mentors in the project	
Integration with faith & scripture (20 pts) ** • Orally describes related biblical theme or passage • Clearly explains connection of faith theme to the project's experimental design or intended outcome	
Communication (20 pts) ** • Communicates information with ease and minimal references to notes • Good eye contact when listening and answering question • Poster display includes visuals and text that are attractive, easy to understand, and clearly summarize major project points	
Total Score =	

*Score range (40 points): Excellent (36-40), Good (28-35); Average (19-27), Below Average (≤18)

**Score range (20 points): Excellent (18-20); Good (14-17); Average (10-13), Below Average (≤9)

Judge's Summary Comments/Suggestions:

Judge Name: _____