Pittsburgh Regional Science and Engineering Fair (PRSEF) 2022

Teachers' and Students' Handbook

Contents

Important Dates and Deadlines

Pittsburgh Regional Science and Engineering Fair (PRSEF) Tuesday, March 22 – Friday, March 25, 2022

Tuesday, March 22 – intermediate Division (7th and 8th grades)

Wednesday, March 23 – Junior Division (6th grade) and Senior Division (9th-12th grades)

Friday, March 25 – Virtual Awards Ceremony

2022 Student Registration Deadlines

School Registration Opens – September 1, 2021

School Registration Closes – November 19, 2021

Student Registration Deadline for projects requiring preapproval – November 19, 2021

Note- All projects involving human subjects, non-human vertebrate animals, potentially hazardous chemicals, activities and devices require pre-approval including those for students from schools with their own fair

Student Registration Deadline – January 7, 2022

Student Registration Deadline for schools with science fairs (excluding students with pre-approval projects) – February 4, 2022

Abstract Submission Deadline – February 4, 2022

Regeneron ISEF Student Deadlines (9th – 12th grade only) May 8-13, 2022 Atlanta, GA

The student's research paper and application must be emailed to Carnegie Science Center, Attn: PRSEF Director at PRSEF@CarnegieScienceCenter.org – February 27, 2022 11:59PM

Final paperwork must be submitted to Regeneron ISEF by winners – April 5, 2022

Student must attend ISEF prep session – April 2022

Note: Student must be a PRSEF participant and complete the appropriate paperwork to apply for Regeneron ISEF

See Appendix 1 Science Fair Timelines for additional information

Who, what, why, how?

Who can compete?

Any student in grades 6-12 who resides in Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Clarion, Clearfield, Fayette, Greene, Indiana, Jefferson, Lawrence, Mercer, Somerset, Venango, Washington, or Westmoreland counties in Pennsylvania or in Garrett County, Maryland is welcome to compete at PRSEF.

Why do a research project?

Scientific research helps us to understand the world around us and make it a better place. Through their research students can explore topics which are relevant to them or their community, increase awareness of those issues, explain phenomena in the world around them, advance technology and enrich the lives of those around them. By exploring the world around them through scientific investigation and independent research students gain the skills of

- Critical thinking and observation
- Data analysis
- Perseverance
- Public speaking and communication
- Creativity and problem solving
- Confidence
- Collaboration

In ALL aspects of a student's life, the knowledge and skills gained by completing a science or engineering research project will always be with them personally and professionally. **These are important for any career path**.

Participating in science fair helps students to develop their own STEM identity. Science fairs make science research more accessible to students who may not previously have been able to picture themselves as scientists and can spark a lifelong love of inquiry and experimentation. Interviews with judges, mentorship from local scientists and the interest of their science teacher demonstrate to students that adults value them and their work. Science fair projects are also an effective way for students to solve problems in their community and make their voices heard.

Scientific research is also fun and highly satisfying! STEM clubs or research classes allow students to work together and be part of a team, create a sense of community and camaraderie, and normalize the experience of pre-collegiate research. Science fairs give young scientists a sense of belonging and teamwork.

Please see Appendix 2 Meeting PA State Science Standards and Assessment Anchors.

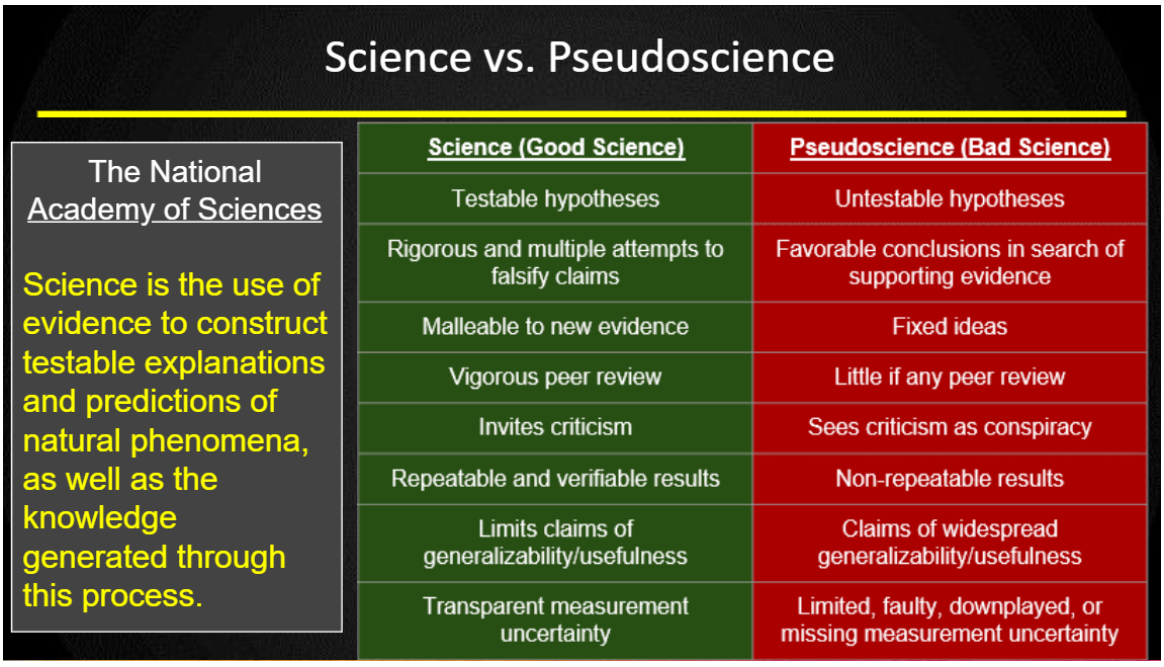
What is a Research Project?

A research project is when you use a step-by-step approach, like the scientific method, to answer a question or solve a problem.

Good scientists, both young and old, follow a similar approach to study what they see in the world. Research is the process by which people create new knowledge about themselves or the world in which they live in order to answer a question or solve a problem. When choosing your topic, give careful thought to how your research might enhance the world and its inhabitants. Questioning is probably the most important part of scientific creativity and is often followed by an "if...then" statement. Questioning usually leads to experiments or observations.

All students should strive to conduct original research and open-ended investigation which is hypothesis-driven. Original research does not seek to repeat or confirm experiments which have already been done, but rather aims to answer a new question. In an open-ended investigation, a student will conduct a series of experiments where the results of one experiment lead to the next question in a repeated fashion.

Students should learn to be skeptical of all research results, especially their own. A good experiment may or may not answer the questions asked, but almost always leads to fresh questions requiring new experiments or observations. The final hypothesis is often developed after the researcher has run a number of preliminary experiments, analyzed a body of results, and reached a tentative conclusion. The results of a student's work must be measurable and, in most cases, quantifiable.



Some projects do not look like what we usually think of when we hear the term "science fair project".

Engineers create things that never were or improve on a previous design. An engineering project should state the engineering goals, the development process and the evaluation of improvements.

Computer science projects involve creating and writing new algorithms to solve a problem or improve an existing algorithm. Simulations, models or "virtual reality" are other areas on which to conduct research.

Mathematics projects involve proofs, solving equations, etc. Math is the language of science and is used to explain existing phenomena or prove new concepts and ideas.

Theoretical projects involve a thought experiment, development of new theories and explanations, concept formation or designing a mathematical model.

Social sciences projects which do not involved an experiment or data are not appropriate for competition at PRSEF.

How do I participate at PRSEF?

Students Should Complete the Following Steps Involved in a Research Project

1. Pick a topic of interest. Use the ideas in Appendix 3 Projects to Avoid for guidance. Some ideas about where to find topics for science fair projects include:

    - The community – what problems do you see, what are you curious about
    - Nature – nearby parks, forests, farms and waterways can provide interesting topics
    - Current events
    - Water analysis of local streams - algae blooms, erosion, salinity
    - Science News for Students, Science News for High Schools, and Science News – all publications of the Society for Science and the Public
    - Science News archived educator guides - available for free at sciencenews.org
    - Society for Science and the Public blog - https://www.societyforscience.org/blog/
    - Summer camps and summer research programs – See Appendix 4 Summer Camps and research programs for a list of opportunities
    - Sustainable development goals published by the United Nations at https://sustainabledevelopment.un.org/
    - The Earth Deconstructed Project
    - Work done by local universities or businesses
    - Published literature

    Publicly available open-source data sets can also be a good source of ideas for a project. Some you might want to explore include:

    - USGS Earth Explorer geological and geographic data
    - NASA image data
    - NASA Geosciences data
    - Infrared astronomy data – IPAC

- Work done by local Geographic Information Systems professionals
- Data about weather conditions at https://www.WeatherSTEM.com and https://data.noaa.gov/datasetsearch/.
- Websites like https://animaldiversity.org/ with information about specific animal species
- CDC disease data
- US Census bureau (demographics, populations, voting)
- The human microbiome project
- Genetic stock collections
- World Bank Open Data
- World Health Organization
- Google Public Data Repository
- Registry of Open Data on AWS
- FiveThirtyEight
- US government open data
- freeCodeCamp
- UNICEF
- Kaggle
- LODUM
- UCI Machine Learning Repository

See Appendix 11 Recommended Chemistry Resources for more ideas about high quality sources for project ideas and for literature review.

2. Ask a question or identify/define a problem related to the chosen topic. Projects at PRSEF should go beyond a review of the literature to include an experiment which answers a new question.
3. Search for and review published materials related to the question or problem. Visit Appendix 5 Links to Recommended PRSEF Resources, Appendix 6 PA Power Library, Appendix 7 Science Projects Research Ideas from Sponsors, Appendix 11 Recommended Chemistry Resources, and **Access PA Power Library** or www.wlnonline.org/PRSEF for appropriate resources. To determine if an internet resource is reliable check the tips at www.WLNnonline.org/PRSEF or https://acscareers.wordpress.com/2013/08/05/its-on-the-internet-it-must-be-true/. Students should do this in November to be ready for PRSEF in March.
4. Develop a research plan. All research plans must include: rationale, research question/engineering goal, hypothesis/expected outcome, procedure, risk analysis and bibliography with at least 5 (five) major references (e.g. science journals, books, articles, internet sites). Sources will be checked and must be well documented. See www.WLNonline.org/PRSEF and Appendix 12 A General Guide for Scientific References for guidelines regarding formatting references. **Urls alone are not acceptable as references to scientific resources.** Reference pages must be written in a recognized professional format (MLA, APA etc.)
5. Teachers: Before registering students for the fair, work with them to choose a category for their project. See Appendix 13 Project Categories for a complete list of categories. Choosing the correct category ensures that the project is evaluated by judges who are appropriate subject matter experts and will increase the chances of a project being recognized with an award.

6. Teachers: Register the project and student online at www.PRSEF.STEMisphere.org and complete Form 1. This will generate all of the required forms for the project. If you are unsure that the forms were generated correctly, use the rules wizard at https://ruleswizard.societyforscience.org/ to help you determine which forms should be required or contact PRSEF@CarnegieScienceCenter.org. Be sure to read Guide to the Scientific Review before completing the forms. The following forms must be submitted for **ALL** projects:
   - Form 1: Checklist for Adult Sponsor
   - Form 1A: Student Checklist
   - Research Plan (page 2 of Form 1A)
   - Form 1B: Approval Form
   - Form 3: Risk Assessment Form

7. Complete, sign and submit the forms at www.PRESF.STEMisphere.org. At a minimum, this part of the process will require participation by the adult sponsor, student, and parent. Other adults may also be involved depending upon type of project. Once the project has been reviewed, you will receive an email either requesting additional information or approving the research project. When you receive a confirmation notice of approval—START YOUR RESEARCH!
8. Challenge and test the hypothesis through experimentation (data collection) and analysis or build and test an engineering model.

   For students who are completing an engineering project, sites like TinkerCAD, Adafruit.com and Arduino may be helpful. Appropriate resources provided to PRSEF by science fair teachers Vince Joralemon and Mike Carapezza can be found at: TinkerCad Worksheets (https://www.tinyurl.com/tinkercadworksheets), Engineering Design Worksheets (https://www.tinyurl.com/edpworksheets2020) and Arduino Activities (https://www.tinyurl.com/arduinoworksheets). Students should do this in January to be ready for PRSEF in March. Note: Keep track of all data in a project data book.
9. Examine and organize the data. Evaluate the results of the experiment or engineering project and reach conclusions based on the data. Use the statistics suggestions in Appendix 14 Using Statistics for ideas about how to analyze data.
10. Write an abstract and add it to your registration file before February 4. Special awards judges will review the abstracts before the fair to select the students they are interested in interviewing on fair day. A high-quality abstract will earn you more interviews. See the section *Abstracts, Presentation Boards and Research Papers* for more information.
11. Prepare a report and presentation board. Write a research paper (required for ISEF applicants only). See the section *Abstracts, Presentation Boards and Research Papers* for more information.
12. Assemble a display and construct a presentation board.

Teachers: All students must be registered and have submitted the required forms at www.PRSEF.STEMisphere.org on or before January 7, 2022 unless the school has a science fair in which case the deadline is extended to February 4, 2022. All projects which require pre-approval, including those from schools with their own science fair, must be submitted by November 19, 2021 and approved before the student begins experimentation.

Teachers: In mid-March, fair day logistics will be emailed to you to share with the students.

Tips For Teachers

Bring in help – Invite local scientists from industry or academia into your classroom to talk to students about their work. Students benefit greatly from knowing that there are adults in the science community who care about them and their research. If you are working with minority students, a scientist who shares their background and heritage – who looks like them - is even more inspirational. Scientists in academia and industry are often looking for partnerships and outreach to fulfill requirements of their grants. You can contact individuals in management at local universities and companies to help you find scientists who have grant obligations.

Broaden your reach - If you can't find anyone local, track down role models through social media or the internet and ask them to visit your classroom virtually. Local Geographic Information Systems professionals who can be found at https://www.gisci.org/Recertification/GISPRegistry.aspx can be a great resource.

Create community – Science is a team sport and groups of students working on related projects or toward a similar goal (like attending PRSEF) benefit from the same sense of community which a sports team would benefit if you create the community. You can create a feeling of belonging by giving students a time and space to gather and collaborate. Host a community night during which families, friends, local business owners and other students can see student work. Invite students from lower grades to see your students' projects and allow the older students to plan science demonstrations for the younger students. Encourage students to work in the community to find inspiration for project ideas and support for their ideas.

Encourage summer research – There are numerous summer research programs for high school students in the Pittsburgh area. Encourage your students to apply to these programs to give them a head start on their projects.

Communicate, communicate, communicate – Students need lots of reminders to stay on track, especially when a project takes place over such a long period of time. Use class announcements, hard copy messages to parents, the Remind app for texting, YouTube videos with instructions, emails to parents and any other method you can think of to keep students on track. The more varied the communication is, the more likely you are to reach everyone.

Engage parents – The parents of student researchers are most likely not scientists themselves; they might not even know anyone who is a scientist. They do not need to understand the intricacies of the project (or even much of the vocabulary), but they can still help with transportation to and from local labs or after-school STEM club meetings, listen to the students practice their presentations, supervise progress toward due dates and milestones, and offer encouragement. If a parent believes that their child can be a scientist, the child is more likely to believe it themselves.

Be flexible – Students are so busy with other activities, after-school jobs, family obligations, and homework! Try to offer multiple times and options for them to work with you on their project. If they can't attend the club meeting after school because they don't have a ride home if they miss the bus, offer to meet with them before homeroom or make yourself available by phone.

Use free resources from Society for Science and the Public – Explore www.ScienceNews.org and www.SocietyForScience.org under Outreach and Equity. You can find free Science News (high school) and Science News for Students (middle school) articles, archived educator guides from Science News, e-newsletters, an online community of science teachers and the advocate program for special support for underrepresented and low income student populations.

Use the technology which is available – Students do not need to work in a university level lab to do great science. Simple model organisms like pill bugs, bean beetles, planarians, fruit flies, brine shrimp, onions, garlic, herbs, lichen, and legumes among others can be used to do very interesting science fair projects. The model organism does not need to be complex; it just needs to match the research question. The most important parts of the project are not the complexity of the technology used, but the uniqueness of the question, the creativity of method, and the reliance on iterative use of the scientific method.

Encourage your students to publish their work - Reach for the stars! The following journals publish pre-collegiate research. Submitting student research to them will give them access to professional peer review.

- National High School Journal of Science
- Journal of Student Research
- Journal of Student Science and Technology
- Journal of Emerging Investigators

Need more help? Ask the Science Fair Director! Send an email to PRSEF@CarnegieScienceCenter.org or call 412-237-1534. We are always here to help support you and your students.

Abstracts, presentation boards and research papers

Abstracts

After finishing research and experimentation, students are required to write a (maximum) 250-word, one-page abstract. An abstract should include: (a) purpose of the experiment, (b) procedures used, (c) data, and (d) conclusions. It also may include any possible research applications. Projects do not need to be completed to submit an abstract. You can simply state that experimentation is continuing, and results will be available on fair day. Only minimal reference to previous work may be included. The abstract should focus on work done since the last PRSEF and should not include: a) acknowledgments, or b) work or procedures done by the mentor.

It is in the student's best interest to submit an abstract prior to the fair. Special awards judges have access to student abstracts prior to competition day and use them to determine which projects address their special areas and are eligible for their prize. In addition, category judges review abstracts prior to interviews for a summary of the research. Abstracts must be submitted online at STEMisphere.org/PRSEF by the adult sponsor or the student.

A completed abstract MUST be submitted online on or before February 4, 2022.

Abstract Samples –

Project Title: *What Type of Trash Makes the Most Biogas*
Fossil fuels are becoming a rare resource because they are nonrenewable. My experiment provides us with an alternative way to produce gas. I wanted to find out which type of organic material produces the most biogas. To do that, I pureed apples, blueberries, onions, and lettuce, put them in bottles filled to the top with water, and sealed the top with a balloon. Then, every day for a week, I measured the circumference of the balloon. After the one week, the apples ended up producing the most biogas, rejecting my hypothesis that the blueberries would produce the most biogas.

Project Title: *Landfill Chemistry*
Landfills are a major problem and this study evaluated ways to increase the decomposition rate of newspaper, a common ingredient. Eight simulated landfills were built, and the rate of the decomposition of newspaper was tested by adding various agents: "yeast with Yeast Energizer," "Campden Tablets," and "Amalayse Enzyme." Microbial growth and biodegradability of the newspaper were then examined. Newspaper treated with Alpha Amylase underwent a significant increase in decomposition as compared with untreated samples and the other agents. Future studies are being planned in an effort to increase the decomposition rate of plastics and organic garbage.

Project Title: *Cetuximab_DHA Antitumor Effect*
Cetuximab is EGFR-specific antibody treatment for head and neck cancers. Since only 10-20% of patients respond clinically, there is an interest in enhancing cetuximab's efficacy. Docosahexaenoic Acid (DHA) is an omega-3 fatty acid that can inhibit tumor progression. The effects of combining DHA and cetuximab on cell proliferation, EGFR expression, and antibody dependent cell-mediated cytotoxicity (ADCC) were studied in vitro. Combination treatment better reduced proliferation, and DHA upregulated phospho-EGFR while combination treatment mitigated this effect. Pre-treatment of tumor cells with DHA increased ADCC by healthy donor effector cells. These findings show co-administration enhances the antitumor effects the treatments had alone.

Presentation Board

- The standard presentation board is a three-panel (24" middle panel with 2 12" side panels), free-standing structure that folds for ease in transporting to and from the fair. Be sure to adhere to the specific size limitations and safety rules. Presentation boards can be purchased at a local office supply store. Your board may not exceed the following:
    - Width: 48" (122 cm)
    - Depth: 30" (76 cm)
    - Height: 78" (198 cm) for tabletop exhibits, 108" (274 cm) for floor exhibits. Note: Please inform the Covestro PRSEF office of floor exhibits prior to Covestro PRSEF.
    - Weight: no more than 250 lbs. All exhibits exceeding 100 lbs. must be mounted on a dolly with rubber casters. Oversized exhibits will be disqualified.
- All exhibits must be freestanding (no wall mounts).

- Students must set-up their own project displays. Heavy, wooden, double-stacked, plastic or metal display boards are not recommended.
- Make sure the display is sturdy. It must remain intact all day.
- Include only the current year's work.
- Contents should include: title, purpose, hypothesis, procedure, results, conclusion.
- Project data books, abstracts, and research papers are not required, but recommended. (Judges evaluate your research, any three-dimensional objects displayed are incidental.)
- Three-dimensional demonstration materials but are not required, but may also be used as part of the exhibit.
- All photos must have a credit line of origin ("Photograph taken by..." or "Image taken from..." or "Graph/Chart/Table taken from…"). Consent forms are required for all human test subject pictured in photographs. All images MUST BE properly cited.

Display Safety

- **"When in doubt, do without."** Leave glassware and chemicals at home.
- Do not bring...
    - Living organisms, including plants
    - Taxidermy specimens or parts
    - Preserved vertebrate or invertebrate animals
    - Human or animal food
    - Human/animal parts or body fluids (for example, blood, urine)
    - Plant materials (living, dead, or preserved) which are in their raw, unprocessed, or non-manufactured state (Exception: manufactured construction materials used in building the project or display)
    - Laboratory/household chemicals including water (Exceptions: water integral to an enclosed apparatus)
    - Poisons, drugs, controlled substances, hazardous substances or devices (for example, firearms, weapons, ammunition, reloading devices)
    - Dry ice or other sublimating solids
    - Sharp items (for example, syringes, needles, pipettes, knives)
    - Flames or highly flammable materials
    - Batteries with open-top cells
    - Awards, medals, business cards, flags, endorsements and/or acknowledgments (graphic or written) unless the item(s) are an integral part of the project
    - Photographs or other visual presentations depicting vertebrate animals in surgical techniques, dissections, necropsies, or other lab procedures
    - Active Internet or e-mail connections as part of displaying or operating the project
    - Glass or glass objects (Exception: glass that is an integral part of a commercial product such as a computer screen)
- Any apparatus deemed unsafe by the Scientific Review Committee, Lead Inspector or PRSEF personnel will be removed during the Inspection Process.

Tips for Presentation Boards

- A Good Title - Your title should be simple, accurate and an attention-grabber. It should make the observer want to know more.
- Organization - Make sure your display is logically presented and easy to read. A glance should permit anyone (particularly the judges) to quickly locate the title, experiments, results, and conclusions. When you arrange your display, imagine that you are seeing it for the first time. When you assemble your pdf file, make sure that the logical flow of your poster isn't lost.
- Eye-catching - Make your project stand out. You could do this by including photographs, using neat, colorful headings, charts, and graphs. Pay special attention to the labeling of graphs, charts, diagrams, and tables - each item must have a descriptive title. Anyone should be able to understand the visuals without further explanation.
- Ask adults for advice when needed.
- Your goal is to make the observer want to know more. Make it easy for interested judges to assess your study and the results. Use clear and concise elements. Headings should stand out. Draw graphs and diagrams clearly and label them correctly.

Project Data Book

A project data book is your most treasured piece of work. Record accurate and detailed notes to make a logical and winning project. Good notes show consistency and thoroughness to the judges and will help you when writing your research paper. Judges highly recommend displaying a data book.

Research Paper (Required for Regeneron ISEF and for Senior Division PRSEF students)

Senior Division students must submit a research paper. This document must be a PDF file 2.5MB or less in size. The paper must include an abstract, rationale, research question, hypothesis, procedure, results, data analysis, and conclusions. Research papers may include excerpts from a project data book and any other relevant written materials.

A research paper helps organize data as well as thoughts. A good paper should resemble a paper which could be published in a scientific journal. Check www.wlnonline.org/PRSEF for examples of scientific journals and what the papers there contain. The research paper should be no more than 20 pages long. Relevant data tables should be included in appendices. The appendices are not included in the 20-page limit.

Elements of the research paper

- **Title Page and Table of Contents** – The title page and table of contents allows the reader to follow the organization of the paper quickly.
- **Abstract** – Summary of your experiment in 250 words.
- **Introduction** – The introduction sets the scene for your report. The introduction includes the purpose, your hypothesis, problem or engineering goals, an explanation of what prompted your research, and what you hoped to achieve.
- **Materials and Methods** – Describe in detail the methodology used to collect your data or make your observations, design apparatus, etc. Your report should be detailed enough so that

someone could repeat the experiment from the information in your paper. Include detailed photographs or drawings of self-designed equipment. Only include this year's work.

- **Results** – The results include data and analysis. This should include statistics, graphs, etc.
- **Discussion** – The discussion section is the essence of your paper. Tell your readers exactly what you did and thought. Compare your results with theories, published data, commonly held beliefs, and expected results. Discuss possible errors. How did the data vary between repeated observations of similar events? How were results affected by uncontrolled events? What would you do differently if you repeated this project? What other experiments should be conducted?
- **Conclusion** – Briefly summarize your results. Be specific. Do not generalize. Never introduce anything in the conclusion that has not already been discussed. This is a good place to discuss practical applications.
- **Appendix including acknowledgments** – Credit those who assisted you, including individuals, businesses, and educational or research institutions. Note any financial or material donations. Do not list teachers, parents, schools, etc. by name. Relevant data tables may also be included in an appendix.
- **Bibliography** – Include any documentation not your own (i.e., books, journal articles). See an appropriate reference in your discipline, www.WLNonline.org/PRSEF or Appendix 12 A General Guide for Scientific References for format (ie. APA, MLA or Chicago Manual of Style) to learn more about how to format your bibliography. Urls alone are not acceptable references.

Other Items to bring to the fair

- Signed copies of forms. Although copies were submitted with the registration form, students should bring a duplicate set to the fair.
- Ideas, knowledge and enthusiasm. Students will be interviewed by the judges. They should understand their research and be able to communicate their process and results research effectively.

Fair Day Interviews

Communicating your science is a skill which must be developed just like your wet lab techniques. When talking about your project to others you should:

- Explain why your project is important not only to you but also to the person you are talking to, your community or society as a whole. Using a who, what, when, where, why, how approach is helpful for introducing the most important points.
- Be clear and avoid using complicated technical terms which the other person might not understand. Explain to your audience what your findings mean and what broader applications they might have.
- Be honest - even if your results did not support your hypothesis or if you don't know the answer to a question. Acknowledge the limitations of your current project when asked. Telling a judge that you don't know the answer to a question and then suggesting ways you might be able to find that answer is strongly encouraged.
- Remember that you are the expert on your work. Nobody knows your project better than you do (even the judges), but they are interested in learning more and need for you to teach them.

- Practice, practice, practice. The more times you present your work and the more varied your audiences are, the better you will get at communicating your science. It doesn't matter if your audience knows a lot about science or not – post your talk on social media (with your parent's permission), ask younger scout troops if you can present to them for a badge, tell your parents, siblings, aunts, uncles, teachers, neighbors and friends about your work and try to answer their questions in simple terms.
- Bring your ideas, knowledge and enthusiasm.

Fair Week Schedule

Fair Days Schedule – Wednesday, March 22-25, 2022

Tuesday, March 22 - Intermediate Division
Wednesday, March 23 - Junior Division and Senior Division
Friday, March 25 - Virtual Awards Ceremony

Use the directions and map at http://www.carnegiesciencecenter.org/visit/parking-directions/ for information about parking and entrances.

Student Schedule

7:00 am – 9:00 am
Registration in Group Services on the ground floor, Project set-up and inspection - Student Exhibit areas, Carnegie Science Center

9:00 am – 9:50 am
Student orientation - Carnegie Science Center, various locations

10:00 am – 12:30 pm
Interviews with judges - Student Exhibits areas in Carnegie Science Center

12:30pm (Junior Division only)
Dismissal

12:30 pm – 2:00 pm
Lunch break - RiverView Café at Carnegie Science Center

2:00 pm – 4:00 pm (Intermediate and Senior Division only)
Sponsor Award Judging / Presentation - Students are not permitted to leave until 4:00 pm

4:00 pm– 4:30 pm
Dismissal, Parent pick-up, Buses Depart

Teacher Schedule

8:00 am – 9:30 am
Check-in – Registration desk in Group Services, Ground floor of Carnegie Science Center

8:00 am – 2:00 pm
Hospitality Room, Carnegie Science Center, Highmark SportsWorks

9:00 am – 12:00 pm
Teacher Workshop at the Fab Lab in the Carnegie Science Center - Introduction to STEM Making - Digital fabrication. Three hours of ACT 48 credit will be given to all participants. Pre-registration is required.

12:00 pm – 1:00 pm
Join students for lunch in the RiverView Café at Carnegie Science Center

2:00 pm – 4:00 pm
View student projects and interview students throughout Carnegie Science Center

4:00 pm – 4:30 pm
Meet students at designated dismissal areas.
Note: Students are not permitted to leave the exhibit floor until 4:00 pm

4:30 pm – 5:00 pm
Buses Depart

Virtual Science Fair Awards Ceremony – Friday, March 25, 2022 - 6:00 pm

Rules of Participation

See 2022 PRSEF guidelines and 2022 ISEF guidelines for full details.

Ethics Statement: Scientific fraud and misconduct are not condoned at any level of research or competition. This includes plagiarism, forgery, use or presentation of other researcher's work as one's own and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs and Regeneron ISEF. PRSEF reserves the right to revoke recognition of a project subsequently found to have been fraudulent.

- You must not have reached age 20 on or before May 1, 2022.
- Must be in grades 6-12.
- You must live in one of the following counties: **PENNSYLVANIA:** Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Clarion, Clearfield, Fayette, Greene, Indiana, Jefferson, Lawrence, Mercer, Somerset, Venango, Washington, Westmoreland or **MARYLAND:** Garrett.
- Team Projects (2 or 3 students) are permitted in all divisions. All team members must attend grades which are assigned to the same division. For example, a sixth grader (junior division) cannot work with a seventh grader (intermediate division). All team members must be present on Fair Day.
- Pittsburgh Regional Science & Engineering Fair is the ONLY science fair in Western PA which is affiliated with the Regeneron International Science & Engineering Fair. Please note for students new to your school (moving from other regions), a student may compete in only one ISEF affiliated fair in any one school year.
- The project must be solely the work of the exhibitor(s) in research, construction and design of the exhibit. Parents or sponsors may only advise. (Supervision and assistance with the use of power tools is exempt.)
- All work must be done within the 12 consecutive months and must begin no sooner than the January of the year prior to competition year (work for projects competing at PRSEF in 2022 must begin in sooner than January 2021). Continuation projects which rely on previous work and include a new research question or method of collecting/analyzing data are acceptable. Only work done during the current fair year may be presented in the competition. Form 7 must be completed for continuation projects.
- **Note:** Teachers that sponsor students from different schools (ie. Intermediate, high school) must register each school separately.
- Each student MUST HAVE an adult sponsor (parent /teacher/mentor) who is ultimately responsible for the health and safety of the student conducting the research and of any human or animal subjects. An adult sponsor may be a teacher, parent, university professor or scientist who has a solid background in science and will closely supervise the student's research.
- All students (in all divisions) conducting research involving vertebrate animals, human subjects, tissue, recombinant DNA, microbes, and pathogenic or controlled substances, must fill out special

approval certification forms (See 2022 PRSEF Guidebook BEFORE starting the project. Paperwork deadline for these projects is November 19, 2021.

- **Human Participant Studies -** Projects involving the consumption, ingesting, tasting, applying, absorbing of any substance will be accepted with the approval of both the local Institutional Review Board (IRB) on Form 4 and of the PRSEF Scientific Review Committee (SRC). Research completed at a Regulated Institution and approved by the institution's IRB on Form 4 will be accepted by the PRSEF SRC if said research falls within the Society for Science's rules. Topics of study which could engender a feeling of shame, inadequacy, social exclusion, or prejudice including studies involving deception, social preference, friends, race/racism, religion, abuse, bullying, weapons, drugs, alcohol, mental illness, depression, girlfriend/boyfriend issues are prohibited. **PRSEF's SRC reserves the right of final approval of all other projects submitted to the competition. See Human Participants for more information**

- **Bacteria Projects:** Many students collect bacteria in a home environment. This is acceptable as long as the collected bacteria are immediately transported to a lab with the appropriate level of biosafety containment and petri dishes remain sealed throughout the rest of the experiment. See Potentially Hazardous Biological Agents for more information.
- **Mold Projects:** Many students observe mold growth on food. This is acceptable as long as the experiment is terminated at the first evidence of mold.
- High school seniors that are enrolled in college courses are eligible provided they are also enrolled in high school and will receive their diploma in the academic year in which they participate in PRSEF.
- Students must be present at their project boards during the official judging time(s) on fair day. The exhibit area is a restricted area during official judging. **ONLY students, judges, and official PRSEF volunteers/ staff are permitted on the exhibit floor during category judging times.**
- The Category Award Selection Procedure has been designed to ensure all projects are evaluated on a consistent basis and ranked appropriately with regard to receiving awards. The decisions of the judges, determined on the day of the fair, are final. See Appendix 13 Category Award Selection Procedure for details.

Judging and Category Award Selection Procedure

Students should be ready to talk in depth about their research. They should be able to have a conversation about their work and results. Students should practice explaining their research to parents, friends, teachers, and especially people who don't understand their research. They should tell everyone to ask them at least three questions.

Judges look for well thought-out research. They consider how significant the project is in its field, as well as how thorough the student was in conducting their research. Did they leave something out? Did they start with four experiments and finish only three?

Judges recognize students who can speak freely and confidently about their work. They are not interested in memorized speeches, but prefer simply to TALK with students about the project to see if they have a good grasp of their research from start to finish. Note cards are permitted, but students should not read from them. Besides asking the obvious questions, judges often ask questions to test

students' insight into their project, such as, "What was your role?" or "What didn't you do?" and "What would be your next step?"

Judges expect the student to demonstrate that they did the work themselves.

Some students who compete at PRSEF have had opportunities to work in industrial research or teaching hospital labs. Students, parents and judges have expressed concern about equity in judging these projects in competition with those done in more traditional places, i.e., home or school labs. PRSEF strives to maintain a level playing field.

Research is usually an activity that proceeds faster when ideas are exchanged and techniques are shared. This is especially true whenever the ideas shared are in part generated by a specialist or scientist working actively in the field in question. A student stands to gain considerable knowledge by association with these professionals and also usually has access to the latest research equipment. ***To this point, however, it is essential that the judge determine how the student connected with the lab. A student who chose the project and created the lab situation will be more highly rated than one who was led to those choices by someone of influence. The judge is evaluating the creativity of the student, not the mentor.***

The student researcher shall convince the judges of the following:

- ***The student did all of the work***. All of the work reported must be done by the student. It is unacceptable to present other's work, and any project doing that will be disqualified.
- ***A higher level of science is expected***. Whenever work is done in these labs it is expected to be more complex and advanced. In and of itself, this shall not influence a judge's evaluation. More complex science is usually presented in these cases; this is as expected and does not influence the rating.
- ***The student has a complete understanding of the work reported***. Each judge shall thoroughly test the student's knowledge of the subject. If a judge is not familiar with the science of the project a Category Chair shall be notified and other judges assigned. Here especially, judges shall not be satisfied with "canned" presentations.
- ***The student made use of the tools available***. The judge shall determine how effectively the student used resources available in the lab.

When deciding which of these projects to advance for Category awards, judges shall consider the judges' rubric attributes (See Appendix 16 Judges' Rubrics) and reward projects that have scored well against those criteria. Just as judges are not unduly influenced by a flashy poster, they should not automatically assume that these are better science projects.

See Appendix 15 Category Award Selection Procedure for details about the judging and award selection process.

Science Fair Awards

Pittsburgh Regional Science and Engineering Fair (PRSEF) awards fall into several different categories.

Category Awards - Awards are distributed based on the number of entries in each category. Multiple second, third and fourth place awards may be awarded. Only one first place will be awarded in each category.

Senior Division (Grades 9 – 12)

$300 – First Place
$150 – Second Place
$75 – Third Place
$25 – Fourth Place

Intermediate Division (Grades 7 – 8)

$150 – First Place
$75 – Second Place
$35 – Third Place
$20 – Honorable Mention

Junior Division (Grades 6)

$75 – First Place
$50 – Second Place
$30 – Third Place
$15 – Fourth Place

Note: Teams will split the award money equally among team members.

Regeneron International Science and Engineering Fair (ISEF) Awards

Senior Division, Grades 9 – 12
Each student researcher entering an exhibit may apply for participation in the International Science and Engineering Fair (ISEF). Senior division student researchers will be chosen from the applicants and will win an all-expenses paid trip to compete at ISEF.

Junior and Intermediate Division (Grades 6 – 8)
The top 10% of middle school students (usually Category Award Winners in 1st, 2nd & 3rd places) are nominated to advance to Broadcom MASTERS competition, a program of Society for Science and the Public.

Sponsor Awards

Companies which sponsor PRSEF may award a $50 prize to a student of their choosing. Sponsors use their own criteria to select projects. Some look for projects from their special field of interest. See Appendix 7 Science Project Research Ideas from our Sponsors, Appendix 8 Expected Affiliated Sponsors Awards, Appendix 9 Expected Scholarship Awards, and Appendix 10 Expected Sponsor Awards for more information.

Affiliate Sponsor Awards - PRSEF is a regional science fair affiliated with the International Science & Engineering Fair (ISEF). Affiliated sponsor awards are presented at PRSEF based on criteria received from ISEF.

Scholarships - Senior Division PRSEF participants (9th-12th grade) are eligible to be judged and receive scholarships from participating colleges and universities. More than 100 scholarships are expected to be awarded.

Perseverance Awards

Honorary Scientist
Eleventh and twelfth grade students with five or more years of active participation.

Associate Scientist
Eleventh and twelfth grade students with three or four years and tenth grade students with four or five years of active participation.

Junior Scientist
Eighth and ninth grade students with three or four years of active participation.

Merit Awards - Category Judges select the students who exhibit excellence in Creativity, Presentation, Scientific Method or Literature Review. Students will receive a certificate of excellence that signifies his or her outstanding performance in one of these areas.

Conditions of Awards
All cash awards will be paid in the year they are awarded, if the student has provided the necessary documentation (W9 forms) to process payment. Awards not distributed within one year of the award date will be subject to forfeiture. Internal Revenue Service (IRS) regulations require that Carnegie Institute file IRS Form 1099 for Miscellaneous Income for recipients of award monies which total $600 or more during a calendar year. Award recipients will receive their copy of Form 1099 from Carnegie Institute in January of the year following the year award payments are made.

Sponsors
The Pittsburgh Regional Science & Engineering Fair is presented by Covestro, FedEx Ground and leading corporations, foundations, professional societies and universities in this region.

Appendix 1 Science Fair Timeline

Steps to a Successful Project	Suggested Time Required
CHOOSE a topic/explore your world—almost anything can be the basis for a science project	1 week
RESEARCH your topic at the library to find background information on the general topic to narrow the topic	1-2 weeks
FORMULATE a question to explore the topic, DESIGN an experiment to answer the question and WRITE a research plan	2 weeks
COMPLETE required forms at PRSEF.STEMisphere.org	1 week
GATHER materials to do the experiment	1 week
BEGIN the experiment, OBSERVE and record data	Varies depending on the experiment
ORGANIZE recorded data into charts, graphs, tables	2 weeks
ANALYZE data using quantitative methods and form conclusions	2 weeks
PREPARE display and presentation	1-2 weeks

Important Dates to Remember

Item	Due Date
School Registration and Fee	Friday, November 19, 2021
Student Registration Forms (includes Form 1, 1A, Student's Research Plan, 1B, and 3)	November 19, 2021 for pre-approval projects (human participants, bacteria, vertebrate animals) January 7, 2022 for projects without pre-approval or a school science fair February 4, 2022 for schools with school science fairs
Student's Abstract entered online	On or before Friday, February 4, 2022
Submit Preliminary Application to PRSEF for Regeneron International Science & Engineering Fair (ISEF) 9^{th}-12^{th} grade students only	February 27, 2022 at 11:59PM
PRSEF Competition	March 22-23, 2022
PRSEF Awards Ceremony	Friday, March 25, 2022

Visit www.pittsburghsciencefair.org for recommended websites and project ideas from our sponsors.

Appendix 2 Meeting PA State Science Standards and Assessment Anchors

Richard Close
Director of Outreach Delaware
Valley Science Fairs

There has been much discussion and debate regarding the value of students doing student science research projects. In doing science research projects students follow what is known as the "Inquiry Cycle" (similar to but significantly different from the old "scientific method"). The Inquiry Cycle has 8 parts:

1) the student identified question to be solved,
2) background research,
3) experimental design (procedure) to follow,
4) data taking through completion of the procedure,
5) analysis of data,
6) conclusions based on empirical evidence from the experiment,
7) dissemination of the findings to peer group/ professional scientists and
8) new question(s) raised from dissemination.

This sets the stage for another research question as new questions are raised from others and the process repeats itself.

From this it can be seen that logical problem solving is practiced by the student if they follow these steps. But how does this help the students meet the Pennsylvania Science and Technology Standards? How are they prepared for the PSSA Assessments that will be starting in Spring, 2007? To see, let's look at the State Science Standards and the newly released

"Assessment Anchors" and "Eligible Content" that will drive the PSSA Science Assessment. There are 8 major areas that the standards are divided into. These standards comprise what the students of Pennsylvania are expected to know and be able to do in the areas of Science, Technology and Environmental Education. (These are found at the PDE website.) The areas identified are:

1) Unifying Themes of Science
2) Inquiry and Design
3) Biological Sciences
4) Physical Science, Chemistry and Physics
5) Earth Sciences
6) Technological Education
7) Technological Devices

8) Science, Technology and Human Endeavor

Standards 1, 2, 6, 7 and 8 bring in new areas of thinking for the students. They will be highlighted to demonstrate that by **having students doing student science research, they will have opportunities to learn, practice and "hone" their skills and knowledge in these areas.**

Standards 3, 4 and 5 -- Biological Sciences, Physical Science, Chemistry and Physics, and Earth Sciences are the content-driven standards. These areas key on facts and concepts of science disciplines. Portions of the content of the various science disciplines, as identified in standards 3, 4 and 5, would be addressed in science research project as the students 1) do the background research for the problem or area under consideration and 2) perform the experimentation— "doing the science" that reveals the content identified in the content standards. A student researcher must know and understand the underlying, foundational concepts—the knowledge--- identified in these standards so that they can understand and extend the learning from the research project. As can be seen standards 3, 4 and 5 are compatible with rather than in opposition to the inquiry and process standards 1, 2 6, 7 and 8. ("**Knowledge** -- facts, principles, theories and laws verifiable through scientific inquiry by the world community of scientists; includes physics, chemistry, earth science and biological sciences.")[1]

In **Standard 1---Unifying Themes of Science**--- students are challenged to be able **to identify the concepts of systems, model design, patterns, scale and change** in the natural world. This is a key area that student researchers develop as they complete their experimental design (through systems and "scale usage") and make their observations through quantitative data measurement. Then by analysis and interpretation the researcher develops their skills in seeing patterns, change and model design to answer their initial research question. **The research project gives the students a real-life opportunity to see how these unifying themes in science can be observed through their own experimentation and inquiry.**

In **standard 2**, **Inquiry and Design**, students are challenged to "develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variables, manipulating variables, interpreting data, and producing solutions."[1]

In addition, they are to "apply the elements of scientific inquiry to solve problems by:

- Generating questions about objects, organisms and/or events that can be answered through scientific investigations.
- Evaluating the appropriateness of questions.
- Designing an investigation with adequate control and limited variables to investigate a question.
- Conducting a multiple step experiment.
- Organizing experimental information using a variety of analytic methods.
- Judging the significance of experimental information in answering the question.
- Suggesting additional steps that might be done experimentally."[1]

[1] **Academic Standards for Science and Technology,** Pennsylvania Department of Education, 2002.

Where will students have the opportunity to have these rich, scientific experiences on an ongoing basis--not a once a week, "guided inquiry", cookbook lab that most science texts provide**? Students and teachers will find that through the completion of a long-term student science research project they will be continually experiencing these scientific process skills while still dealing with the content and knowledge demanded by the state and national science standards.**

Standard 6 and 7 deals with **Technology Education** and **Technological Devices**. Depending on the project selected the student will have a greater or lesser amount of learning about technology, technological tools and technological problem solving. However, since almost all projects use computers and measurement devices, there is a portion of the standards that science research projects work with. Such standard indicators as "select and safely apply appropriate tools, materials and processes necessary to solve complex problems" and "apply advanced tool and equipment manipulation techniques to solve problems"[1] point to the student use and understanding of measurement and to the use of technology to solve problems, which is done during student science research projects. In addition, the standards statement "apply basic computer operations and concepts" challenges students to use computers in their problem solutions, **something that is done as they complete their student science research project.**

Standard 8 encompasses **Science, Technology and Human Endeavors**. This area requires the student to be able to analyze and apply solutions of science to real world conditions. Standard statements such as:

> 1) Analyze the relationship between societal demands and scientific and technological enterprises,
>
> 2) Analyze how human ingenuity and technological resources satisfy specific human needs and improve the quality of life and
>
> 3) Evaluate possibilities consequences and impacts of scientific and technological solutions require students to be able to apply their science learning to real world situations and conditions. This aspect too is part of student-driven science research. The student scientist is required to apply their investigation and project to a real-world application. For many students, this is a first-time experience of taking something they have "discovered" and think through how to apply this learning to a practical situation or condition. Rarely will students be asked to apply learning like this. Often textbook learning requests an application but seldom do teachers have students think about how their investigative discovery could apply to a real-life situation. **Once again, the student science research project provides the means for standards-driven learning.**

[1] **Academic Standards for Science and Technology,** Pennsylvania Department of Education, 2002.

The new PA Science Assessment Anchors provide teachers and students "eligible content" that the PSSA Science Assessment could incorporate in the assessment, starting in 2007. A few of the following are areas of "eligible content" that are strongly dealt with through the performance of student science research projects:

- Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
- Explain how specific scientific knowledge or technological design concepts solve practical problems
- Analyze or compare the use of both direct and indirect observation as means to study the world
- Use appropriate quantitative data to describe or interpret change in systems
- Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
- Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate and communicate results) applicable to a specific technological design.
- Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
- Critique the results and conclusions of scientific inquiry for consistency and logic.
- Communicate results of investigations using multiple representations.
- Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations
- Analyze and predict the effect of making a change in one part of a system on the system as a whole.
- Use appropriate quantitative data to describe or interpret a system
- Compare the accuracy of predictions represented in a model to actual observations and behavior.
- Describe or interpret recurring patterns
- Analyze stationary patterns and physical patterns of motion to make predictions or draw conclusion

  (taken from **Assessment Anchors for Science and Technology,** Pennsylvania Department of Education, 2004.)

These along with any of the content pieces that the student science research project deals with demonstrates once again the great value of having students meet the standards as well as preparing for the state science assessment **by using the science research project platform.**

In Closing

Knowledge of what science is incorporates carefully developed and integrated components:

- **Nature of Science**
- **Unifying themes of science**

- **Inquiry**
- **Process skills**
- **Problem solving**
- **Scientific thinking**

As you can see from the above summarization from the Pennsylvania Science & Technology Standards, students must learn science by doing. Inquiry is the key component for understanding science. How do students experience this? **By doing science as real scientists!** Where do they get the experiences like this? **By doing science research!** What platform allows this to happen on an ongoing, long-term basis? **Student Science Research Projects!**

Appendix 3 Top Projects to Avoid

Science Project Topics to Avoid	Why
Any topic that boils down to a simple preference or taste comparison. For example, "Which tastes better: Coke or Pepsi?"	Such experiments don't involve the kinds of numerica measurements we want in a science fair project. They are more of a survey than an experiment.
Most consumer product testing of the "Which is best?" type. This includes comparisons of popcorn, bubblegum, make-up, detergents, cleaning products, and paper towels.	These projects only have scientific validity if the Investigator fully understands the science behind why the product works and applies that understanding to the experiment. While many consumer products are easy to use, the science behind them is often at the level of a graduate student in college.
Any topic that requires people to recall things they did in the past.	The data tends to be unreliable.
Effect of colored light on plants	Several people do this project at almost every science fair. You can be more creative!
Effect of music or talking on plants	Difficult to measure.
Effect of running, music, video games, or almost anything on blood pressure	The result is either obvious (the heart beats faster when you run) or difficult to measure with proper controls (the effect of music).
Effect of color on memory, emotion, mood, taste, strength, etc.	Highly subjective and difficult to measure.
Any topic that requires measurements that will be extremely difficult to make or repeat, given your equipment.	Without measurement, you can't do science.
Graphology or handwriting analysis	Questionable scientific validity.
Astrology or ESP	No scientific validity.
Any topic that requires dangerous, hard to find, expensive, or illegal materials.	Violates the rules of virtually any science fair.
Any topic that requires drugging, pain, or injury to a live vertebrate animal.	Violates the rules of virtually any science fair.
Any topic that creates unacceptable risk (physical or psychological) to a human subject.	Violates the rules of virtually any science fair.
Any topic that involves collection of tissue samples from living humans or vertebrate animals.	Violates the rules of virtually any science fair.

Source: http://www.sciencebuddies.org/science-fair-projects/project_question.shtml#examples

What Makes a Good Science Fair Project Question?	For a Good Science Fair Project Question, You Should Answer "Yes" to Every Question
Is the topic interesting enough to read about, then work on for the next couple months?	Yes / No
Can you find at least 3 sources of written information on the subject?	Yes / No
Can you measure changes to the important factors (variables) using a number that represents a quantity such as a count, percentage, length, width, weight, voltage, velocity, energy, time, etc.? Or, just as good, are you measuring a factor (variable) that is simply present or not present? For example, Lights **ON** in one trial, then lights **OFF** in another trial, **USE** fertilizer in one trial, then **DON'T USE** fertilizer in another trial.	Yes / No
Can you design a "fair test" to answer your question? In other words, can you change only one factor (variable) at a time, and control other factors that might influence your experiment, so that they do not interfere?	Yes / No
Is your experiment safe to perform?	Yes / No
Do you have all the materials and equipment you need for your science fair project, or will you be able to obtain them quickly and at a very low cost?	Yes / No
Do you have enough time to do your experiment more than once before the science fair?	Yes / No
Does your science fair project meet all the rules and requirements for your science fair?	Yes / No
Have you checked to see if your science fair project will require SRC (Scientific Review Committee) approval?	Yes / No
Have you avoided the bad science fair project topic areas listed in the "Science Project Topics to Avoid" table?	Yes / No

Source: http://www.sciencebuddies.org/science-fair-projects/project_question.shtml#checklist

Appendix 4 Summer Camps and Research Programs

Research Opportunities in Pittsburgh

UPMC Hillman Cancer Research Center Academy
https://hillmanresearch.upmc.edu/training/high-school-and-undergrad/

Summer research program in the Health Sciences at University of Pittsburgh
https://www.howscienceworks.pitt.edu/high-school-students

Health Careers Scholars Academy at University of Pittsburgh
http://www.hcsa.pitt.edu/

INVESTING NOW at the Swanson School of Engineering
https://www.engineering.pitt.edu/InvestingNow/

Magee-Womens Research Institute Summer Research Program
https://mageewomens.org/for-researchers/education/high-school-summer-internship-program

Summer Health Career Academy
https://www.southwestahec.org/hca

Summer Academy for Math and Science at Carnegie Mellon University
https://www.cmu.edu/pre-college/academic-programs/sams.html

AI4All@Carnegie Mellon
https://www.cmu.edu/pre-college/academic-programs/ai4all-at-carnegie-mellon.html

Pre-College Computational Biology at Carnegie Mellon
https://www.cmu.edu/pre-college/academic-programs/computational-biology.html

National High School Game Academy at Carnegie Mellon
https://www.cmu.edu/pre-college/academic-programs/game-academy.html

Pennsylvania Governor's Schools for the Sciences at Carnegie Mellon
http://sciences.pa-gov-schools.org/

Road to Research (R2) at Carnegie Mellon
https://www.cmu.edu/gelfand/researchatcmu/index.html

STEM outreach programs at Carnegie Mellon University
https://www.cmu.edu/gelfand/education/k12-students-parents/highschoolprograms.html

Western Pennsylvania STEMM Academy
https://www.facebook.com/Western-Pennsylvania-Summer-STEMM-Academy-344346792342010/

Summer Science Nation at Carlow University
https://www.carlow.edu/summerworkshops/

The Citizen Science Lab

https://www.thecitizensciencelab.org/

CSI Summer Camp at Point Park University
https://www.pointpark.edu/Academics/Schools/SchoolofArtsandSciences/Departments/CriminalJusticeandIntelligenceStudies/CSISummerCamp

SEMS-ROC at Robert Morris University
https://www.rmu.edu/academics/schools/sems/research-outreach

Research Outside of Pittsburgh

Horizon Academic
https://www.horizoninspires.com/

Research at Rutgers University
https://aresty.rutgers.edu/resources/other-programs/research-programs-rutgers-research-for-high-school-students

Boston Leadership Institute
https://www.bostonleadershipinstitute.com/

Biosphere 2 at University of Arizona
https://biosphere2.org/education/student-environmental-leadership

SummerFuel program at MIT
https://www.summerfuel.com/technology-art-design/MIT

Camp Psych at Gettysburg College
https://www.gettysburg.edu/academic-programs/psychology/student-opportunities/camp-psych/

Summer Internship Program at Johns Hopkins School of Medicine
https://www.hopkinsmedicine.org/som/Opportunities-High-School-Undergraduate-Postbac-Students/sip.html

Health and Biomedical Sciences Camp at Lebanon Valley College
https://www.lvc.edu/life-at-lvc/summer-community-programming/health-biomedical-sciences-camp/

Summer@Rensselaer at Rensselaer Polytechnic Institute
https://summer.rpi.edu/

Bulldog Pharmacy Camp at Samford University
https://www.samford.edu/pharmacy/bulldog-pharmacy-camp

PennSummer at the University of Pennsylvania
https://www.sas.upenn.edu/summer/programs/high-school

Research Summer Institute at MIT
https://www.cee.org/research-science-institute

Summer research opportunity lists and search engines

https://www.careercornerstone.org/pcsumcamps.htm

https://www.connectwithcinch.com/

https://study.com/academy/popular/biomedical-engineering-summer-programs-for-high-school.html

https://www.bestcollegereviews.org/features/pre-college-summer-science-programs-high-school-students/

https://www.pathwaystoscience.org/K12.aspx

https://www.collegetransitions.com/top-summer-programs-for-high-school-students/

http://csne-erc.org/education-resources-teachers/summer-research-experiences-high-school-students

Camps for Girls in STEM

Galaxy Girls at Assemble
http://assemblepgh.org/summer-camps/

Summer Engineering Experience for Girls at CMU
https://engineering.cmu.edu/education/stem/programs/see.html

Changemakers Lab at The Ellis School https://www.theellisschool.org/life-at-ellis/summer-camp/changemakers-lab#works

Appendix 5 Links to Recommended PRSEF Resources

Determining Reliable Internet Sources

If a publication is listed in a reputable source, like those below, you can be assured that they are accurate and legitimate:

PRSEF Research Resources from the Westmoreland Library Network

NASA Headquarters Library

NASA Jet Propulsion Laboratory Video Series
How to do a Science Fair Project

Rubber, Plastic and More - Top Science Project Ideas

Carnegie Library Science & Technology Resources
Articles, Databases & More

Access PA POWER Library
(A research database) Requires a library card

International Science and Engineering Fair

The World-Wide Web Virtual Library: Science Fairs

Broadcom MASTERS Program

Discovery Young Scientists Challenge

Neuroscience for Kids

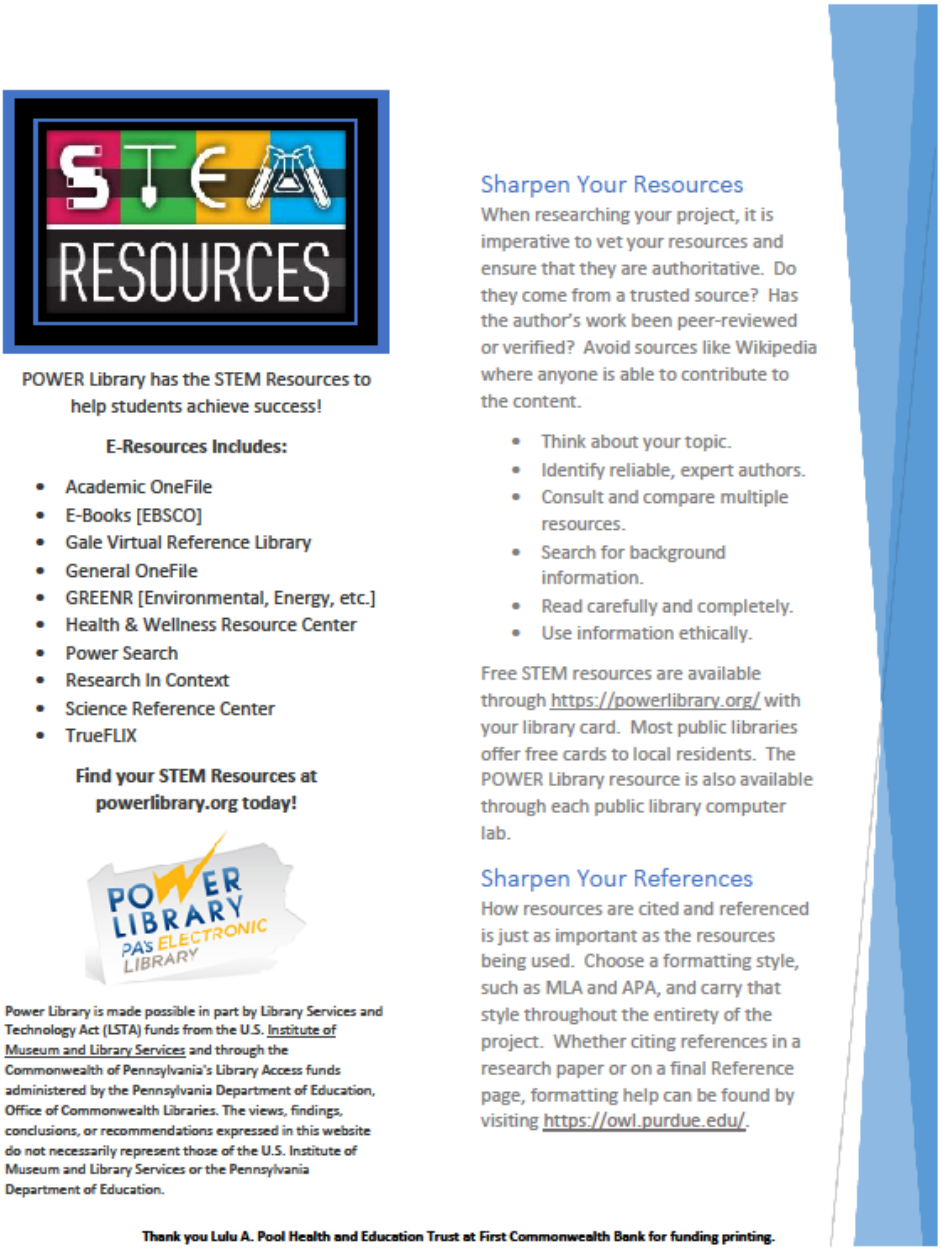
PubMed
A database of all published biomedical literature

Google Scholar
References to scholarly literature

See also, Appendix 10 Recommended Chemistry Resources

Appendix 6 PA Power Library

The Westmoreland County Library has compiled an excellent website full of high-quality sources and information about how to conduct a literature review and format a references page. This webpage can be found at www.WLNonline.org/PRSEF.



STEM RESOURCES

POWER Library has the STEM Resources to help students achieve success!

E-Resources Includes:

- Academic OneFile
- E-Books [EBSCO]
- Gale Virtual Reference Library
- General OneFile
- GREENR [Environmental, Energy, etc.]
- Health & Wellness Resource Center
- Power Search
- Research In Context
- Science Reference Center
- TrueFLIX

Find your STEM Resources at powerlibrary.org today!

POWER LIBRARY PA's ELECTRONIC LIBRARY

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Sharpen Your Resources

When researching your project, it is imperative to vet your resources and ensure that they are authoritative. Do they come from a trusted source? Has the author's work been peer-reviewed or verified? Avoid sources like Wikipedia where anyone is able to contribute to the content.

- Think about your topic.
- Identify reliable, expert authors.
- Consult and compare multiple resources.
- Search for background information.
- Read carefully and completely.
- Use information ethically.

Free STEM resources are available through https://powerlibrary.org/ with your library card. Most public libraries offer free cards to local residents. The POWER Library resource is also available through each public library computer lab.

Sharpen Your References

How resources are cited and referenced is just as important as the resources being used. Choose a formatting style, such as MLA and APA, and carry that style throughout the entirety of the project. Whether citing references in a research paper or on a final Reference page, formatting help can be found by visiting https://owl.purdue.edu/.

Thank you Lulu A. Pool Health and Education Trust at First Commonwealth Bank for funding printing.

Appendix 7 Science Project Research Ideas from our Sponsors

Our sponsors are a very important part of the Pittsburgh Regional Science & Engineering Fair. To increase the number of projects to be considered for a Sponsor Award, Sponsors have supplied us with project criteria to encourage students to conduct research related to the sponsor's field of interest.

Research Projects Related to Air & Water Pollution
Air & Waste Management of Western PA Section will present student awards related to air and water pollution.

Research Projects Related to ALCOSAN
ALCOSAN will present awards to student research projects that prove in what way(s) pollution affects the environment. It is required that the project presents the different types of pollution, as well as their effects. The research project must demonstrate high-level thinking and reasoning, knowledge of the subject area, and a concern for water quality.

Research Projects Related to Allegheny County Health Department
Students will be awarded in the areas of environmental health, air pollution and public health.

Research Projects Related to Allegheny County Medical Society Alliance and Foundation
Awards will be presented to students with projects in a topic related to Medicine. Projects should demonstrate ideas that could improve health care for patients in the future or promote quality improvement in a medically related area. The projects should demonstrate knowledge of the subject area and how it relates to the field of Medicine. Winning projects should promote healthy living, improve public health and/or the advancement of medicine.

Research Projects Related to American Society for Quality
American Society for Quality will present awards to students who apply quality techniques to his/her project. The judging criteria are: the students' ability to eloquently and accurately describe their project and a theme of quality within the project, which often involves the use of statistical methods for high school students or the inclusion of quantitative reasoning for middle school students.

Research Projects Related to American Society of Civil Engineers
The American Society of Civil Engineers, ASCE, Pittsburgh Section will present Science Fair student awards in civil engineering. Projects involving dams and waterways will be considered since they are an integral part of our region. An award in the Junior Division and Senior Division will be presented.

Research Projects Related to Braskem America
Braskem America will present awards to students with projects that demonstrate innovation with a focus on sustainability. We have a special interest in the areas of polymers, plastics, engineering, and chemistry.

Research Projects Related to Carnegie Mellon University, Leonard Gelfand Center for Service Learning and Outreach.

The Leonard Gelfand Center presents awards selected by Carnegie Mellon faculty or students and focus on the judges' area of research.

Research Projects Related to Chemistry
The Pittsburgh Section of the American Chemical Society will award students for projects that demonstrate creativity and knowledge in topics related to chemistry.

Research Projects Related to Electrical Power:
Eaton will present awards for projects in the field of engineering relative to electrical power distribution, which demonstrate creativity and knowledge in topics related to energy efficiency, circuit protection, renewable power, electrical safety or power quality.

Research Projects Related to Electrical and Electronics Engineering - IEEE Award
The Institute of Electrical and Electronics Engineers (IEEE) will present The Institute of Electrical and Electronics Engineers (IEEE) will present awards in the field of electrical and electronics engineering. Winning projects will demonstrate significant knowledge of electrical principles, electronics, robotics, computer design, software development or mathematical techniques. Students are encouraged to submit projects to the Science Fair categories such as Engineering, Robotics, Computer, Physical Science, etc. to be considered for these awards.

Research Projects Related to Industrial Hygiene
The Pittsburgh section of the American Industrial Hygiene Association will present awards in the field of Industrial Hygiene. Winning projects will be based on how well the student understands the health & safety industry which focuses on issues such as indoor air quality, exposure to chemicals, noise, heat/cold, vibrations, and repetitive motion.

Research Projects Related to Mining, Mining Engineering or the Field of Geology or Mineralogy
The Society for Mining, Metallurgy, and Exploration (SME) Pittsburgh Section would like to present an award to a project related to the application of mining and mining engineering or the fields of geology or mineralogy. Creative or innovative uses of modern technology, such as electronics, computerization, and/or robotics, in mining, mineral exploration, geology, mining equipment, miner safety, or mine rescue would merit strong consideration for a prize award.

Research Projects Related to Neuroscience
Projects related in any way to the nervous system will be judged on their use of sound scientific methods and reasoning, and the quality of results obtained. This award is sponsored by the Department of Neuroscience, University of Pittsburgh.

Research Projects Related to Paints, Coatings and Related Materials
PPG will present awards for projects involving chemistry, physics, engineering, or material science which demonstrate creativity and knowledge in topics related to fiberglass, glass, coatings, paints, plastics, inks, adhesive, color, optically transparent material, polymers or chemicals.

Research Projects Related to Pittsburgh Geological Society
Awards will be presented for earth science / geoscience projects that examine how the geologic basis of our environment relates to everyday life. Ideas for project topic areas include the following. A rock

stratagraphic column is a good place to start as it sets the framework for your investigation. Mineral resources are an important part of the Pennsylvania economy and the legacy of historic mining still causes problems of acid mine drainage, mine subsidence and hazardous materials contamination. Coal, oil, and gas development can interact with rural and urban development and affect both the quality and quantity of surface and groundwater resources. The current Marcellus shale gas drilling demonstrates the importance of that resource and its associated environmental controversies to the community you live in. Landslides destroy houses, close roads and disrupt utilities. The recognition of causes is an important municipal planning tool. Knowledge of the various types of rock and their properties are aspects of mineralogy, geochemistry, geophysics, geotechnical engineering and the durability of building materials, even gravestones. Fossils are important to understanding the role of evolution in a changing historical landscape and understanding differences in depositional environments. Western PA even has volcanic rocks. Projects are not limited to Pennsylvania problems. Listen / read the news, look at an outcrop, let your mind wonder to the question Why!

Research Projects Related to Pittsburgh Intellectual Property Law Association (PIPLA)
PIPLA will award students for projects that demonstrate creative ideas resulting in new and functional processes or devices. Projects in Engineering/Robotics, among others, will be considered.

Research Projects Related to Psychoanalysis
Pittsburgh Psychoanalytic Center will make an award(s) that offers a way of understanding ourselves, our relationships and how we conduct ourselves in the world. Winning projects could include the following topics: Dreams, the Unconscious, Development, Relationships, Trauma, or Anxiety/Defense.

Research Projects Related to Sigma XI - Carnegie Mellon University
Sigma XI - Carnegie Mellon University awards a student in any discipline of science or mathematics for a project that shows innovation, diligence, relevance to everyday life and quantitative analysis. We have a special interest in experiment design and use of statistical methods to interpret results.

Research Projects Related to Spectroscopy
An award will be presented by the Spectroscopy Society of Pittsburgh to Science Fair student projects in spectroscopy or its components, including optics, lenses, prisms, mirrors, lasers, dispersion, interference. Winning projects will involve topics dealing with spectroscopy and will have completed all components of the PRSEF project (lab notebook, report and poster).

Research Projects Related to Society of Military Engineers

What is the current condition of the nation's electrical generation and transmission grid and how will carbon reduction mandates, decreased electrical generation by coal, aging infrastructure, and alternative energy sources such as solar and wind affect the reliability of the power grid and the cost of electricity?

Given the impact of aging infrastructure nationwide, and the importance of maintenance to extend the service life, students could evaluate the infrastructure condition in their municipality, the budgets in place to maintain or replace infrastructure, and explore what planning options should be considered for maintenance and replacement of the municipality's infrastructure.

Research Projects Related to Society of Women Engineers
An award will be presented to one middle school female student and one high school female student for research projects showing practical applications of engineering principles (civil, chemical, industrial, mechanical, electrical, environmental, biomedical, software, etc.). Winning projects will demonstrate a creative, yet practical, application of the selected engineering discipline.

Research Projects Related to Sustainable Materials
Covestro will present awards for projects focused on polymer materials and Circular Economy design principles. The winning project will take a future-facing look at expanding the long-term benefits of polymer technologies in areas such as recycling/reuse, energy efficiency and outreach. Solutions based on chemistry, environmental science and engineering will be considered.

Research Projects Related to The Webb Law Firm
The Webb Law Firm will award students for projects that demonstrate creative ideas resulting in new and functional processes or devices. Projects in Engineering/Robotics, among others, will be considered.

Research Projects Related to Thiel College
Thiel College will present awards to projects in the fields of Behavioral and Social Science, Biology, Environment, and Medicine & Health

Appendix 8 Expected Affiliated Sponsors Awards

American Meteorological Society
2 Certificates of Outstanding Achievement - Senior Division projects (9-12th grade) for best atmospheric and related oceanic and hydrologic sciences.

American Psychological Association
1 certificate recognizing outstanding research in psychology under the category of behavioral and social sciences.

ASM Materials Education Foundation
1 certificate for excellence in materials engineering, materials-related concepts and the materials paradigm (i.e. structure-processing-properties-performance relationship).

Association for Women GeoScientists
1 certificate for GeoScience Excellence projects which exemplify high standards of innovativeness and scientific excellence. Projects that increase the public awareness of the geosciences, illustrate interdisciplinary nature of geosciences, promote sensitivity to the earth as a global system will be considered.

Broadcom MASTERS Middle School Program
The top 10% of middle school students (generally 1st, 2nd and 3rd place category award winners in the Junior and Intermediate Division) will be nominated. Each winner will receive a nomination packet to complete.

Environmental Protection Agency
Letters of encouragement to students who have projects in the areas of environmental sciences and environmental engineering

Lemelson Early Inventor Prize
1 certificate and $100 cash prize to an individual or team in the junior or intermediate division who: (1) demonstrates problem-solving by identifying a critical problem; (2) applies empathy and STEM knowledge to find a practical solution; (3) displays entrepreneurial thinking by developing a tangible invention; (4) exemplifies environmentally-responsible thinking in their research and creation of the project.

Mu Alpha Theta
1 Certificate - Demonstrating the most challenging, thorough, and creative investigation of a problem involving modern mathematics in the Senior Division. Project does not need to be in the Math category.

NASA Earth System Science Award
1 Certificate - Presented to the students whose projects offer the Greatest Insight into Earth's Interconnected systems, based on predetermined judging criteria ie. exhibits a clear and focused purpose that displays an Earth systems science perspective; project demonstrates significant creativity in ability and originality.

National Oceanic and Atmospheric Administration
1 Certificate - Winners' research will emphasize NOAA's mission to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs.

Regeneron Biomedical Science Award
1 certificate and $500 award to an exceptional student scientist who not only demonstrates an impressive command of biomedical science and research but also embodies Regeneron's core values and behaviors, known as The Regeneron Way.

Ricoh Americas Corporation
2 Certificates - This award will go to the project whose principles and technical innovations offer the greatest potential for increasing our ability to grow environmentally friendly and socially responsible businesses.

Society for In Vitro Biology
1 certificate for an 11th grade student with an exhibit in the area of plant or animal in vitro biology or tissue culture.

U.S. Agency for International Development (USAID)
1 certificate for a project which is relevant to international development programming and priorities including: agriculture, human rights, education, climate change, gender equity, global health etc.

U.S. Air Force
Will present awards at the regional fairs.

U.S. Metric Association
1 Certificate for a project which involves a significant amount of quantitative measurement and which best uses the SI metric system for measurements.

U.S. Navy/U.S. Marine Corps – Office of Naval Research
5 -10 certificates, letters, medallions and gift cards for projects in the senior and intermediate divisions.

U.S. Stockholm Junior Water Prize/Water Environment Federation
Regional certificates and nomination to enter the State Regional Stockholm Junior Water Prize Competition. Projects related to water quality, water resource management, water protection, water treatment or water treatment will be considered.

Yale Science and Engineering Association
1 certificate/medallion to most outstanding 11th grade student project in the areas of Computer Science, Engineering, Physics, or Chemistry. Student is given "preliminary certificate" and must sign-up online to accept the award.

Appendix 9 Expected Scholarship Awards

Allegheny College will award up to four Trustee Scholarships with a minimum amount of $25,000 per recipient. The recipients must meet the academic scholarship qualifications designated by the Office of Admissions and enroll at Allegheny College following high school graduation. In addition, Allegheny will offer up to four students a discounted rate to attend our Summer Academy experience. Summer Academy is a Pre-College experience that offers an enriching and seriously fun week for highly motivated high school students. Students can earn college credit and focus their experience in one of three areas led by Allegheny's distinguished faculty. Preference for scholarship and summer academy consideration will be given to students who embody the philosophy of the College and wish to explore their diverse interests after high school. Allegheny College is a national liberal arts college where a diverse student body of 1800 students engage in exploration of multiple fields of interest declaring a major and minor in different disciplines.

Carlow University will award up to three students with the Whalen Scholarship, valued at $8,000 ($2,000 per year for a maximum of four years). Eligible students must meet the necessary criteria for admission and enroll at Carlow full-time upon graduation from high school in one of the following majors: Biology (including concentrations in human biology, cardiovascular perfusion, cytotechnology, and a pathway for environmental science), Chemistry, Data Analytics, or Behavioral Neuroscience with Intraoperative Neuromonitoring. Carlow has a strong program in the sciences and has developed several partnerships for advanced study, including an early acceptance program to LECOM. The Whalen Scholarship can be combined with other merit and/or need-based aid not to exceed the cost of tuition.

Carnegie Mellon University will potentially award up to two Pre-College Summer Session Program commuter scholarships valued at $7,150 for 2 courses or $4,270 for 1 course. The Summer Session Program is a challenging credit-bearing program in which students take one or two actual Carnegie Mellon classes for full credit during the summer. The credit can be used at Carnegie Mellon or may be transferred to other universities. Scholarship recipients will be required to apply for admission to the program. The Pre-College program will be fully remote and runs from July 6-August 14, 2021.

Chatham University will award up to four (4) scholarships each valued at $2,000 for undergraduate study. Each recipient must be admitted to and enroll at Chatham the fall semester following high school graduation. Scholarships are renewable annually for a period of four years or 120 credits provided the recipient maintains at least a cumulative GPA of 3.0 and remains enrolled on a full time basis at Chatham.

Duquesne University will award two scholarships valued at $10,000 each to outstanding high school juniors. All scholarships are renewable annually with satisfactory academic progress. Recipients of the awards must meet academic requirements designated by the Office of Admissions, and must enroll in Duquesne University's Bayer School of Natural and Environmental Sciences the semester following their high school graduation. In addition, Duquesne University will offer four CCHS (College Credit in High School) awards. Two of these awards will be designated for courses up to three credits each and two will be designated for participation in the Duquesne University Summer Undergraduate Research Program.

Gannon University will award up to eight (8) Science Fair Scholarships each valued at $8,000 ($2,000 per year for four years) to outstanding high school students. This academic scholarship is renewable each year with a cumulative GPA of 3.0 and continued full time enrollment. Recipients of this award must meet academic requirements designated by the Office of Admissions and enroll at Gannon University as a full-time student the semester following their high school graduation.

Indiana University of Pennsylvania's Kopchick College of Natural Sciences and Mathematics will award scholarships to outstanding high school juniors or seniors. Recipients must meet the academic requirements for admission, and enroll full-time in IUP as a Biochemistry, Biology, Chemistry, Computer Science, Geoscience, Mathematics, Physics or Psychology major. A scholarship will be valued at approximately $30,000 (24 credits per year for four consecutive years.) To qualify for this scholarship the recipient must have a high school cumulative GPA of 3.5, enroll full-time, and maintain a 3.25 grade point average in one of the above listed majors.

La Roche University will award up to four (4) Science Fair Scholarships to rising juniors or seniors, each valued at $8,000 ($2,000 per year for four years) per recipient. Recipients will enroll full-time at La Roche University the fall semester immediately following their high school graduation in one of the following majors: biochemistry, biology, biology forensics, chemistry, chemistry forensics, computer science, exercise and sports science, health sciences, mathematics, pre-dentistry (LECOM), pre-osteopathic medicine 4+ only (LECOM), and pre-pharmacy 4+ only (LECOM). The recipients must meet the academic scholarship requirements designated by the Office of Freshman Admission, including that they have a cumulative grade point average of no less than 3.0 upon graduation from high school, and must remain in good academic standing at La Roche University. This scholarship may be added to other scholarships that La Roche University provides. However, the total amount of the scholarships received may not exceed that total cost of tuition for the year the student enrolls.

Mount Aloysius College will award up to six science fair scholarships of $10,000 ($2,500 per year for four consecutive years). Recipients must meet all academic criteria for admissions and maintain a 3.0 GPA at the college. Recipients must enroll in a science related major as a full-time student the semester following their high school graduation.

Penn State Greater Allegheny will offer up to four – Blue & White scholarships, each valued at $3,000/year for students who enroll full time at PSUGA, the semester following their high school graduation. The scholarship is renewable for a second year provided students maintain specific renewal criteria. Students who remain at Greater Allegheny for their junior and senior years and major in biobehavioral Health, information science & technology or psychology/science option, may also renew their scholarship, provided they meet specific renewal criteria. Students who pursue energy engineering, 3+1 program, may renew their scholarships for the junior year with a minimum CGPA of a 2.0.

Point Park University will offer two (2) scholarships with a value of $5,000 per year. The Department of Natural Sciences, Engineering and Technology will participate in the selection of the recipients. Each

scholarship is awarded for four (4) years of study, provided the student meets the stated renewal criteria. Recipients of the scholarship must meet the academic requirements for admission and enroll at Point Park University.

Saint Francis University will award six Science Fair Scholarships of $4,000 ($1,000 per year for four consecutive years). Recipients must meet academic criteria for admission and scholarship at SFU and enroll in a major with the school of sciences the semester following high school graduation.

Saint Vincent College will award five Science Fair Scholarships. Each scholarship will be valued at $8,000 ($2,000 per year for four years). Students must enroll at Saint Vincent College in a math or science related major the semester following high school graduation.

Seton Hill University will award four Seton Hill University Science Fair Scholarships. Each scholarship will be valued at $8,000 ($2,000 per year for four consecutive years.) Recipients must enroll at Seton Hill University in a math or science major the semester following high school graduation.

Slippery Rock University will award up to 10 undergraduate scholarships valued at $8,000 ($2,000 per academic year for four years) for individuals majoring in Biology, Chemistry, Engineering, Mathematics & Statistics, Geography, Geology and the Environment, Computer Science, Physics, and Psychology at Slippery Rock University. Students must have at least a 3.5 cumulative high school GPA and 1220 SAT (evidence-based reading and writing and math) or 25 ACT composite score to be eligible for the scholarship and be entering the senior year of high school. Recipients will be required to maintain a 2.5 GPA, complete 24 new credits per academic year and be enrolled at Slippery Rock University full-time, following the approved curriculum, in one of the majors listed above. The total financial aid, including this scholarship, may not exceed the total cost of attendance determined by the Office of Financial Aid each year.

Thiel College will award up to four $2,000 scholarships which would be renewable for four years. Recipients must be a junior or senior with a 3.0 cumulative GPA who plans on studying a science related field. The students must stay in a science related field, meet all admission requirements and enroll at Thiel as a full-time student status for all four years following their high school graduation.

University of Pittsburgh at Bradford will award up to four (4) $1,000 scholarships in addition to any Pitt-Bradford merit award for which a student is eligible. Students must meet admissions and scholarship criteria. Awards are renewable annually for a total of 4 academic years. Students must be enrolled full time, have a cumulative GPA of 2.25 or higher and maintain the housing that the scholarship was based on. Enrollment at the Bradford Campus is required. Awards are not transferable to any other Pitt Campus

University of Pittsburgh at Bradford will award up to four (4) $1000 scholarships in addition to any other Pitt-Bradford merit awards for which a student is eligible. Students must meet admissions and scholarship criteria. Awards are renewable annually for a total of 4 academic years. Students must be enrolled full time, have a cumulative GPA of 2.25 or higher and maintain the housing status that the

scholarship was based on. Enrollment at the Bradford Campus is required. Awards are not transferable to any other Pitt Campus.

University of Pittsburgh at Greensburg will award up to 4 University scholarships ranging $2,000 - $3,000. Students must meet admission and scholarship criteria. Awards are renewable annually pending an overall GPA of 3.25 or higher. Enrollment at the Greensburg campus required - awards are not transferable to another Pitt campus.

Washington and Jefferson College will award up to four (4) scholarships valued at $8,000 ($2,000 per year renewable for a maximum of 4 years). Scholarships will renew annually provided the recipients maintains a cumulative GPA of 3.0 and maintain full-time enrollment. Recipients of this award must meet the Office of Admissions' academic requirements, enroll as full-time students, and live on campus the semester following their high school graduation. W&J has strong programs in the sciences and pre-health professions. Scholarship winners are not required to choose a specific major upon entry to the college but are encouraged to explore their many passions through research experiences and internships before declaring a major.

Appendix 10 Expected Sponsor Awards

The following Sponsors are expected to present awards at the 2022 Science Fair

Air & Waste Management Association

ALCOSAN

Allegheny County Health Department

Allegheny County Medical Society Foundation

American Chemical Society, Pgh. Section

American Industrial Hygiene Association

American Society for Quality

American Society of Civil Engineers, Pgh Section

American Statistical Association, Pgh. Chapter

Arconic

Braskem

Carnegie Mellon University, Chapter of Sigma Xi

Carnegie Mellon University Leonard Gelfand Center for Service Learning and Outreach

Carnegie Robotics

Chemical Association of Pittsburgh

Covestro LLC

Eaton Corporation

Facebook

FedEx Ground

Fluor Marine Propulsion

HATCH

Institute of Electrical & Electronics Engineers, Inc.

Magee-Womens Research Institute

National Institute of Occupational Safety and Health (NIOSH)

Pittsburgh Coal Mining Institute of America

Pittsburgh Geological Society

Pittsburgh Intellectual Property Law Association

Pittsburgh Psychoanalytic Center

PPG

Princeton Alumni Association of Western PA

Range Resources

Sherwin Williams

Society for Analytical Chemists of Pittsburgh

Society for Mining, Metallurgy & Exploration

Society of American Military Engineers

Society of Women Engineers

Spectroscopy Society of Pittsburgh

The Webb Law Firm

Thiel College

University of Pittsburgh, Department of Neuroscience

Young Women in Bio

Appendix 11 Recommended Chemistry Resources

PRSEF Chemistry Category Judges' Preferred Bibliographic Resources

Charles B. Greenberg, Ph.D., Category Co-chair

A. About the "Science Enterprise" Generally

1. Krieger, Melanie Jacobs, *How to Excel in Science Competitions, Revised and Updated,* Enslow Publishers, Berkeley Heights, N.J. (1999).

2. Dashefsky, H. Steven, *High School Science Fair Experiments*: *Environmental Science*, McGraw-Hill, New York (1994). [Senior Chemistry level].

3. Bortz, Fred, *Revolutionary Discoveries of Scientific Pioneers*, 8 volumes, Rosen Publishing Group, New York (2014).

4. Gribbon, John, *The Scientists: A History of Science Told Through the Lives of Its Greatest Inventors,* Random House, New York (2002).

B. Intermediate School Chemistry

See Senior Chemistry below too and explore to your grade-appropriate comfort level for each subject. For example, the Encyclopedia Britannica, which is listed as reference #7 for Senior Chemistry, will also often serve Intermediate School Chemistry. So, do not hesitate to browse, and then move on to the next resource.

1. American Chemical Society, *Chemistry for Life*: http://www.middleschoolchemistry.com. [Protons, Neutrons and Elements; Finding Volume; Why Does Water Dissolve Salt?; The Periodic Table; Molecules in Motion]

2. Environmental Protection Agency, *A Students Guide to Global Climate Change:* https://www3.epa.gov/climatechange//kids/index.html.
CBGreenberg, Ph.D. 08/17/14 Senior Chemistry Category Co-chair

3. Gardner, Robert, Tocci, Salvatore, & Rainis, Kenneth G., *Ace Your Chemistry Science Project: Great Science Fair Ideas*, Enslow Publishers, Berkeley Heights, N.J. (2010). [Organized into five chapters: "Chemical Properties," "Acids and Bases," "Temperature," "Volume and Pressure."]

4. Mebane, Robert C. & Rybolt, Thomas R., *Adventures with Atoms and Molecules: Chemistry Experiments for Young People,* Enslow Publishers, Berkeley Heights, N.J. (1998).

5. Mebane, Robert C. & Rybolt, Thomas R., *Everyday Material Science Experiments," series: Air & Other Gases; Metals; Plastic & Polymers; Salts & Solids; Water & Other Liquids,* Twenty-First Century Books, New York (1995*).*

6. Museum of Science & Industry, Chicago, *Online Science* https://www.msichicago.org/education/learning-resources/.

7. Smithsonian Science Education Center, *Middle School Teaching Resources: https://ssec.si.edu/.* [Subjects include electricity, energy, optics, properties of matter, weather and climate.]

C. Senior Chemistry *(but not excluding Intermediate Level resources)*

1. American Museum of Natural History, *Power of Poison*: https://www.amnh.org/exhibitions/the-power-of-poison.

2. Bourne, Jr., Joel K., *Green Dreams*, National Geographic (October 2007): https://www.cbsd.org/cms/lib/PA01916442/Centricity/Domain/1622/Article%20I2%20-%20Green%20Dreams.pdf.

3. Carbon Dioxide Information Analysis Center: https://cdiac.ess-dive.lbl.gov/.

4. Carnegie-Mellon University/National Science Digital Library (NSDL), *Resources to Teach and Learn Chemistry*: http://www.chemcollective.org/find.php. [Subjects include stoichiometry, thermochemistry, kinetics, equilibrium, acid-base chemistry, solubility, oxidation-reduction and electrochemistry, analytical chemistry lab techniques, and physical chemistry.]

5. Carson, Rachel, *Silent Spring,* Houghton Mifflin Harcourt, Boston (2002). [The classic book about how chemical pollutants impact life on earth; free download at https://archive.org/details/fp_Silent_Spring-Rachel_Carson-1962.]

6. Chemical Education Digital Library: http://www.chemeddl.org. [Access Periodic Table Live!, Models 360, ChemPRIME and more for searches.]

7. Encyclopedia Britannica, *Chemistry*: https://www.britannica.com/science/chemistry. [Broad coverage; if you are not a subscriber, just ignore the ads, which are the price for free access to the site.]

8. Environmental Protection Agency, *Data and Issues*: http://www.epa.gov.

9. Gardner, Robert & Shore, Edward A., *Math & Science in Nature, Finding Patterns in the World Around Us,* Scholastic Library Publishing, New York (1994). [Useful for applying statistical analyses to experimental data.]

10. Gay, Kathlyn, *Water Pollution,* Scholastic Library Publishing, New York (1990).

11. Gay, Kathlyn, *Air Pollution,* Scholastic Library Publishing, New York (1990).

12. Government Science, numerous topics: http://www.science.gov

13. Kirk-Othmer Encyclopedia of Chemical Technology, 4th (or 5th) Edition, 27 volumes plus K-O Concise Encyclopedia of Chemical Technology, John Wiley & Sons, New York (1991-99). [Excellent resource, but

affordable only by major public libraries, universities and corporate libraries. See Carnegie Library of Pittsburgh, University of Pittsburgh Library, or Carnegie-Mellon University Library: free print reference; online with password access.]

14. Miodownik, *Stuff Matters,* Houghton Mifflin Harcourt, Boston (2014). [About various materials such as steel, glass, paper, textiles and more.]

15. National Science Foundation, *Classroom Resources for Chemistry and Materials*: http://www.nsf.gov/news/classroom. (*Lots and lots of excellent, user-friendly video resources for Intermediate and Senior levels on Chemistry & Materials, Earth & Environment, Nanoscience and more. A great place to start your bibliographic search.)*

16. National Renewable Energy Laboratory, *Alternate Energy and Biofuels*: https://www.nrel.gov/workingwithus/re-biofuels.html.

17. National Science Digital Laboratory: https://nsdl.oercommons.org/ [Browse the resource categories.]

18. Royal Society of Chemistry, *Learn Chemistry*: http://www.rsc.org/learn-chemistry/resource. [Lots of online videos on numerous subjects.]

19. Sandia National Laboratories, *Energy and Climate:* http://energy.sandia.gov. [Renewable Systems such as fuel cells and biomass, as well as the Combustion Research Facility, are linked.]

20. Spectroscopy Society of Pittsburgh: http://www.ssp-pgh.org/educational-software-video. [Access to free educational software]

21. Stwertka, Albert, *A Guide to the Elements, Revised Edition,* Oxford University Press, London, (1998).

22. Woods Hole Oceanographic Institution: *Ocean Chemistry*: http://www.whoi.edu/main/topic/ocean-chemistry; *Climate & Ocean:* http://www.whoi.edu/main/topic/climate-ocean.

Appendix 12 A General Guide for Scientific References

Students are required to list at least 5 (five) major references (e.g. science journals, books, articles, internet sites will be checked and must be well documented) in their research plans. Referencing sources correctly is crucial for purposes of academic integrity and of students' future success in higher educational pursuits.

Below are examples of what types of information to include in references, descriptions of what that information entails and how to find it, and formatting requirements for those references.

Basic Reference Structure:

Author(s), title, journal name, journal identifying information (year date, volume, issue, page(s)), web address (if any), date accessed (if web based)

Anatomy of a reference:

Author: The names of the people who wrote the reference. If this is an anonymous publication, such as a report from a government agency, you would list the government agency.

Title: the name of the article. If this was a report from a government agency, the name of the report. It this was a news item, even from web source, this is the headline. If this is a web item, it's the title at the beginning.

Journal name: the name of the book or journal. If this was a news item, it would be the newspaper, or the web-based news site, with the date.

Web address: If the source was obtained from the web, then this is the exact URL which would bring up the content cited. If this is a print journal or a print newspaper which you are viewing on-line, then you don't need to reference the web address, because this exists on paper.

Date accessed: This is the date on which you viewed the material you are citing. This is important because information on websites can be edited at any time.

Examples of different types of sources:

Book: Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge*. London, United Kingdom: Sage., pp 3-4

Article in Edited Volume: Bricmont, J. (1996). Science of chaos or chaos in science? In P. R. Gross, N. Levitt, & M. W. Lewis (Eds.), *The flight from science and reason* (Annals of the New York Academy of Sciences, Volume 775, pp. 131-175). New York, NY: The New York Academy of Sciences.

Journal Article: Ormerod, R. J. (1998). Beyond internal OR groups. *Journal of Operational Research Society*, *49*(4), 420-429. N.B., If an article is from a print journal, you don't need to add a URL, even if you read the article on line.

Journal Article (Online): Vukotich, C. J., Jr., Cousins, J., & Stebbins, S. (2014). Building sustainable research engagements: Lessons learned from research with schools. *Journal of Research Practice*, *10*(1), Article M1. Retrieved from http://jrp.icaap.org/index.php/jrp/article/view/381/324 (1/10/17)

Web Page (No Date): Banathy, B. H. (n.d.). *The evolution of systems inquiry* (Part 1). Retrieved December 1, 2013, from http://www.isss.org/primer/evolve1.htm

Web Page (No Author): *JRP Focus Areas*. (2013, January 14). Retrieved January 7, 2017, from http://jrp.icaap.org/miscfiles/jrp_focus_areas.html

NOTES:

Listing only a URL is never acceptable.

Wikipedia is not an acceptable academic reference; however, Wikipedia uses standard references, which you can use in your literature search. While Wikipedia is often accurate, it may contain information or references which are not reliable.

Academic references should be of high quality and should be peer reviewed. Please check LibGuides.com or https://www.WLNonline.org/PRSEF for information about how to evaluate a source and its legitimacy.

Appendix 13 Project Categories

Individuals and team projects of the same scientific discipline will compete in the same category. Students will select a project category and type (individual/team) during registration. A team consists of 2 or 3 members who are all in grade levels which allow them to compete in the same division. For example, a seventh grader and an eighth grader would both be in the intermediate division and may work together; however, a sixth grader and a seventh grader would be in two different divisions and may not work together.

Junior Division - Grade 6

Behavioral and Consumer Sciences These projects will explore consumer products and the science of how people respond to the world around them. The areas include: Consumer Related (Consumer Product Testing, Consumer Product Design and Enhancements, Comparisons and Evaluation of Commercially Available Products), Behavioral Science Related (Psychology, Human and Animal Behavior, Learning and Perception, Educational and Testing, Surveys),

Biological Sciences These projects will explore living things, including plants, animals and humans, and the things which affect them. The area includes**:** Life Science Related (Biology, Botany & Zoology, Photosynthesis, Plant Growth, Biochemistry, Genetics & Inherited Traits), Health Related (Nutrition, Human and Animal Behavior, Allergies, Exercise, Studies of Animal/Human Health)

Chemistry These projects will explore chemistry, which includes study of any kinds of chemicals. These areas include: Chemistry Related (Organic & Inorganic Chemistry, Chemical Compounds, Household Chemicals (chemistry focus, not functional emphasis), Chemical Engineering) **Note**: If the project focuses on the biological impact/effect of the chemical, then the project should be placed in the biological category.

Physical Sciences & Engineering These projects will explore physics which includes our mechanical world, and engineering, which includes building things and solving problems: **Physics Related (**States of Matter, Optics and Photography, Sound and Acoustics, Heat, Cold and Thermal, Conductivity, Pressure and Vacuum, Electricity and Magnetism, Friction, Inertia, Gravity, Density), **Engineering Related (**Mechanical Engineering, Transportation, Buildings and Bridges, Planes, Trains, Boats and Cars, Sports, Robotics, Computers, Energy Production, Conversion and Storage, Alternative Energy, such as Wind and Solar)

Intermediate Division - Grade 7 and 8

Behavioral and Social Science: human and animal behavior, social and community relationships - psychology, sociology, anthropology, archaeology, ethnology, ethnology, linguistics, learning, perception, urban problems, reading problems, public opinion surveys, educational testing, etc.

Biology: botany, zoology, genetics, biochemistry, including hormones, molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, etc.

Chemistry: inorganic, organic, physical materials, plastics, fuels, pesticides, metallurgy, etc.

Consumer Science: projects in the areas of consumer product testing and design.

Computer Science/Math: Computer Science - Scientific study of computers themselves and their uses, including: 1. Methods of programming/coding, computation, data processing, systems control, algorithmic properties, artificial intelligence, computer theory; and 2. Design and development of various application-based software.

Mathematics - including statistical methods, calculus, geometry, abstract algebra, number theory, probability, etc.

Note: Projects that use computers as a tool to investigate another problem, but that do not involve advanced programming, computer science or statistical methods should not be assigned to this category.

Earth / Environment: pollution and sources of control, ecology, geology, mineralogy, oceanography, meteorology, climatology, geology, seismology, etc.

Engineering / Robotics: technology; projects that apply scientific principles to manufacturing and practical uses - civil, mechanical, aeronautical, chemical, heating and refrigerating, transportation, electrical, photographic, sound, automotive, marine, etc.

Medicine & Health/Microbiology: bacteriology, virology, fungi, bacterial genetics, etc.; study of diseases and health of humans and animals - dentistry, pharmacology, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.

Physics and Astronomy: solid state, optics, acoustics, particle, nuclear, plasma, superconductivity, fluid and gas dynamics, magnetism, quantum mechanics, biophysics, astronomy etc.

Senior Division - Grades 9 - 12

Behavioral and Social Science: human and animal behavior, social and community relationships - psychology, sociology, anthropology, archaeology, ethnology, ethnology, linguistics, learning, perception, urban problems, reading problems, public opinion surveys, educational testing, etc.

Biology: botany, zoology, genetics, biochemistry, including hormones, molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, etc.

Chemistry: inorganic, organic, physical materials, plastics, fuels, pesticides, metallurgy, etc.

Computer Science / Math: Computer Science - Scientific study of computers themselves and their uses, including: 1. Methods of programming/coding, computation, data processing, systems control,

algorithmic properties, artificial intelligence, computer theory; and 2. Design and development of various application-based software.

Mathematics - including statistical methods, calculus, geometry, abstract algebra, number theory, probability, etc.

Note: Projects that use computers as a tool to investigate another problem, but that do not involve advanced programming, computer science or statistical methods should not be assigned to this category.

Earth / Environment: pollution and sources of control, ecology, geology, mineralogy, oceanography, meteorology, climatology, geology, seismology, etc.

Engineering / Robotics: technology; projects that apply scientific principles to manufacturing and practical uses - civil, mechanical, aeronautical, chemical, heating and refrigerating, transportation, electrical, photographic, sound, automotive, marine, etc.

Medicine & Health / Microbiology: bacteriology, virology, fungi, bacterial genetics, etc.; study of diseases and health of humans and animals - dentistry, pharmacology, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.

Physics / Astronomy: solid state, optics, acoustics, particle, nuclear, plasma, superconductivity, fluid and gas dynamics, magnetism, quantum mechanics, biophysics, astronomy, etc.

Appendix 14 Using Statistics

As a tool to strengthen the use of statistical techniques in science fair projects, students should consider using the following statistical techniques (only if statistics are applicable) in presenting and analyzing data collected for their projects:

Junior Division

Graphical Presentation:

- Multiple samples
- Plotting data on graphs
  - X-Y charts
  - Pie charts
  - Bar charts

Intermediate Division

Statistical Analysis:

- Measure with dot plot
- Non-linear plots
- Numerical summaries
  - Median, mean
  - Percentiles, standard deviation

Senior Division

Hypothesis Testing:

- Z-test, T-test, Chi Square and when to use each
- Normal Distribution
- Linear Regression
- Least-squares curve fit

Statistical Advice for a Project

- A general rule for sample size is 10 minimum per case. When comparing 2 groups use at least 8 samples each. Seek a minimum of 4 samples per group when comparing many groups.
- Present all of the raw data obtained from the experiment and use statistical techniques to analyze them. Present the results of the analysis. Draw conclusions based upon the results of the analysis.
- Describe and explain any experimental data you obtained but that you chose not to use. Explain why you chose not to use the data.
- Using computer programs to plot and analyze data is acceptable. However, make sure that you know how the programs analyze data, what the results mean and why you are using the type of statistical analysis you are using – a judge may ask you to explain it.

Where to look for more information about statistics

- Your library will have several references on statistics and statistical techniques to help you with your project. The math department at your school is also a great resource.
- A good resource for explaining the importance of statistics and uncertainty can be found at https://www.nature.com/articles/nmeth.2613.
- https://www.about.DataClassroom.com is a valuable tool for teachers who want to add statistical techniques to their curriculum.
- Guidelines for evaluating and expressing uncertainty can be found at https://www.nist.gov/pml/nist-technical-note-1297 and https://www.dit.ie/media/physics/documents/GPG11.pdf

Appendix 15 Category Award Selection Procedure

Although there are many ways to reach a decision on category award winners, the following two procedures are simple and avoid the issue of disparity in judges' numerical scoring.

1. After interviews are completed, the judges determine which are the best 1-2 projects they reviewed. If a judge feels that none of the projects they saw are worthy of an award, they should discuss this with their category chair(s). Likewise, if a judge feels that more than the allowed number of projects is worthy of further consideration, this too should be discussed with the category chair(s).
2. These projects are reported to the category co-chairs through a vote or through deliberation to develop a list of projects for consideration for final awards. Depending upon the size of the category, between 6 and 15 projects should be advanced for final awards judging.
3. Each judge records the selected project numbers on the Award Selection Form (See Appendix 7).
4. All of the judges in the category convene for deliberation. Each project is presented to the group by one of the judges who interviewed the student(s).

Procedure A

5. When all projects have been presented to the group, each judge ranks the projects using an electronic voting form or other method determined by the category co-chair, giving their first choice 1 point, the second 2 points and so on. Discussion is encouraged.
6. The ranking scores from each judge are added and the award winners are determined based on the composite scores. The first-place winner is the project with the lowest score, second-place is the next lowest and so on.
7. Judges caucus to discuss the results and confirm that the project with the lowest score is the one which the group agrees is the best project. They repeat that procedure for the other award winners. Co-chair judges shall resolve ties if the selection appears to be at an impasse.
8. Based on the number of entries in each category, multiple second, third and 4th place awards may be awarded. **Only one first place will be awarded in each category**. Judges will follow the Final Category Ranking form to determine how many awards to select.

Procedure B

7. When all projects have been presented to the group, the best of the category shall be chosen by a vote. The group discusses each of the projects and, via a show of hands, asks who among the judges feels that this particular project is worthy of 1st place. The project receiving the most votes is the 1st place selection for the category.
8. The group discusses each of the remaining projects and, via a show of hands, asks which projects are worthy of 2nd place, 3rd place and 4th place. Based on the number of entries in each category, multiple second, third and honorable mention awards may be awarded. **Only one first place will be awarded in each category**. Judges will follow the Final Category Ranking form to determine how many awards to select.

Appendix 16 Judging Rubrics

These rubrics were developed in order to provide constructive feedback to the students. These will be used by Category Judges to determine winners in each category. Please note that this will only be one judge's assessment of the strengths and weaknesses of the student's work given in order to improve future projects. It will not indicate how well the student performed with respect to other PRSEF participants. Each student will be interviewed by at least two category judges.

Some rubrics are tailored for specific applications. Point scores are used as a judging tool. Rubrics less the point values will be provided to the students' teachers after PRSEF. The Category Judge Selection Procedure (See Appendix 15) has been designed to ensure all projects are evaluated on a consistent basis and ranked appropriately with regard to receiving awards. The decisions of the judges, determined on the day of the fair, are final.

Judging rubrics are being revised for PRSEF 2022. Please check back in the fall for the updated rubrics.