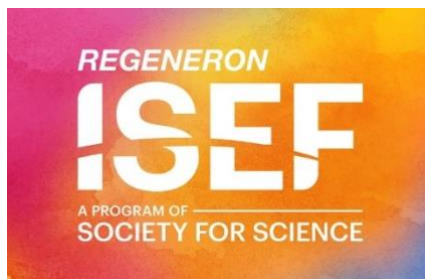


Prince William-Manassas
Regional
**Science and
Engineering
Fair**

2023-24

Participant Handbook

**Prince William - Manassas Regional Science and Engineering Fair
An International Science and Engineering Fair Affiliate**



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The following individuals will handle inquiries regarding nondiscrimination policies, including Section 504 and Title IX:

Mailing Address

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Section 504 Compliance (Students):
Director of Special Education • 703-791-7287

Title IX Compliance:
Title IX Coordinator and Student Equity Office • 571-374-6839

Family Educational Rights and Privacy Act (FERPA):
FERPA Officer • 703-791-7445

Freedom of Information Act (FOIA):
FOIA Officer • 571-402-3150

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Introduction

Dear Regional Science and Engineering Fair Participant:

Congratulations on being selected to represent your school at the Prince William-Manassas Regional Science and Engineering Fair (PW-MRSEF)!

I sincerely hope this year's fair is a productive and rewarding experience for you. It is essential that you read this handbook to become well-informed about the event's structure, procedures, and requirements. Our staff is available to provide additional support.

This year we are utilizing zFairs, a new platform for both registration and the online judging phase. This is where you will upload your presentations by February 23, 2024, 4 p.m. The Virginia State Science and Engineering Fair uses this platform so we think it will make a smoother all-in-one platform for students who win our fair and move onto the next event.

Please contact us if you have questions or require further information. You can contact the PW-MRSEF team at STLN-ScienceFair@pwcs.edu

Sincerely,

A handwritten signature in black ink that reads "Julia Renberg". The signature is written in a cursive style and is enclosed within a thin black rectangular border.

Julia Renberg, Ph.D.

Director, Prince William-Manassas Regional Science and Engineering Fair
Supervisor of Science
Prince William County Public Schools

Schedule of Events and Procedures

All participants must register and upload forms and project components in zFairs by **February 23, 2024, 4 p.m.** Additionally, PWCS students will need to complete the [Parental Consent](#) for zFairs (see page 11 for details).

The 2024 PW-MRSEF will take place in a hybrid format.

Phase I “Virtual” – March 7-13, 2024

- All projects will be evaluated virtually via the zFairs’ platform.
- Participants whose projects qualify for Phase II will be notified on March 14, 2024.

Phase II “In-person” – March 15-16, 2024

- The top six projects from Phase I in each category will advance to Phase II.
- Project check-in and set-up for Phase II will be on March 15, 2024, from 4:30 - 7 p.m. at Kelly Leadership Center, 14715 Bristow Road, Manassas.
- On March 16, 2024, the students will be interviewed by judges to determine first, second, third places and up to three “honorable mention” awards. In the afternoon, first-place finalists in the Senior Division will compete for up to five grand-prize awards.
- The awards ceremonies will take place after grand-prize judging and are open to the public.
- Public webpage announcement of winners: March 21, 2024.

Schedule of Events, March 16, 2024

Time	Event
8:00 a.m.	Student arrival
8:50 a.m.	Parents and public must leave judging area
9 a.m. - 1 p.m.	Project judging
1 p.m. - 3 p.m.	Grand prize judging
3 - 4 p.m.	Kelly Leadership Center is closed
4 p.m.	Awards ceremony for Middle Division (Grades 6-8)
5:15 p.m.	Awards ceremony for Senior Division (Grades 9-12)

Rules for Conducting Experimentation

The PW-MRSEF is an affiliate of the [ISEF](#). Policies and forms are vertically aligned to ensure compliance and consistency for all projects at all levels. Projects that do not adhere to the safety/sanitation guidelines will be disqualified. Please visit the ISEF website for explanations of the [Institutional Review Board \(IRB\)](#) and

[Scientific Review Committee \(SRC\)](#)

Prohibited in Experimentation

- Chemicals listed as “prohibited” can be found in the 2023-24 PWCS Science Education Safety Plan. Contact your school’s Science Instructional Safety Liaison (SISL) or the science team in the Student Learning Department if you have questions and/or concerns.
- All [Drug Enforcement Administration](#) (DEA) controlled substances, prescription drugs, consumable alcohol, and tobacco.
- Laser pointers, firearms, pneumatic guns, and other weapons and ammunition as defined by the [PWCS Code of Behavior](#).
- Ionizing radiation has enough energy to remove tightly bound electrons from atoms, thus creating ions. Examples include high frequency UV, X-rays, and gamma rays.
- Blood, skin cells, urine, saliva, tears, sweat, or other body fluid or tissue not from the student themselves.
- Biological agents that pose the risk of infection or cause harm to the environment, including but not limited to, those that cause tuberculosis, pneumonia, food poisoning, and staph infections.

Allowed in Experimentation

The following low-risk biological agents are allowed but must remain in a sealed environment:

- Baker’s yeast and Brewer’s yeast
- Nitrogen-fixing bacteria, oil-eating bacteria, and *Bacillus thuringiensis* (a common bacterium that lives in soil and is harmful to insects), slime mold, and algae-eating bacteria, and *Lactobacillus* (bacteria found in yogurt and other dairy products)
- Mold grown on food items
- Meat or meat by-products from food stores, restaurants, or packing house
- Hair and sterilized teeth
- Specimens fixed on commercially prepared slides
- Blood, skin cells, urine, saliva, tears, sweat, or other body fluid or tissue from the student themselves ([BSL-1 biohazard](#)) or from a biological supply house/catalog, hospital, or certified doctor/laboratory ([BSL-2 biohazard](#)), provided that the proposal is pre-approved by the school fair SRC
- Non-ionizing radiation normally encountered in everyday life is allowed. Class I lasers of low power or higher power embedded lasers found in laser printers and other office machines, and Class II lasers that emit radiation in the visible portion of the spectrum are allowed.
- Heat and open flames during experimentation are allowed, but only under direct adult supervision.

Chemical Hazards

Related Protocol Forms:

- High School: [ISEF Form 3: Risk Assessment Form](#)
- Middle School: Protocol Form for Research Involving Hazardous Chemical Substances, Activities, or Devices (Grades 6-8)

Considerations when using chemicals:

- Any household chemical requires a risk assessment/protocol form. (Example: vinegar, ammonia, bleach, fertilizer)
- An online search for a Safety Data Sheet for the chemical/product may be useful.

Human Participants

Related Protocol Forms:

- High School: [ISEF Form 4: Human Participants, Sample Informed Consent Statement](#)
- Middle School: Protocol Form for Research Involving Human Participants (Grades 6-8)

Students must obtain prior approval for any project proposal involving humans. Informed consent, document in a written form, is necessary for some research with humans. Obtaining consent involves informing potential participants and the parents or guardians of minors of the potential risks and benefits of the study and allowing the subject to make an educated decision to accept or to decline. Obtaining documented informed consent is not necessary in the following cases:

- Research involving normal educational practices.
- Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the participants' behavior and the study does not involve more than minimal risk as determined by the IRB.
- Surveys, questionnaires, or activities that are determined by the IRB to involve perception, cognition, or game theory, etc. and that do not involve gathering personal information, invasion of privacy or potential for emotional distress.
- Studies involving physical activity where the IRB determines that no more than minimal risk exists and where the probability and magnitude of harm or discomfort anticipated in the research are not greater than those ordinarily encountered in daily life or during performance of routine physical activities.

Vertebrate Animals

Related Protocol Forms:

- High School: [ISEF Forms 5A/B: Vertebrate Animal Form](#)
- Middle School: Protocol Form for Research Involving Vertebrate Animals (Grades 6-8)

Students must obtain prior approval for any project proposal involving vertebrate animals (fish, amphibians, reptiles, birds, and mammals). Alternatives to the use of vertebrate animals for research should be explored. Alternatives include the "3 R's":

- Replace vertebrate animals with invertebrates, lower life forms, tissue/cell cultures or computer simulations
- Reduce the number of animals without compromising statistical validity
- Refine the experimental design to lessen the pain or distress of the animal

Projects involving vertebrate animals must only be observational and not interfere with the organism's normal life processes. There may not be handling of the vertebrate animal in any way that interferes with its life processes. It is recommended that a veterinarian is consulted in experiments that involve supplemental nutrition and/or activities that would not be ordinarily encountered in the animal's daily life. The following studies on vertebrate animals are prohibited:

- No vertebrate organism may be subjected in any way to stress (nutritional deficiency, oxygen deprivation, etc.) Behavioral studies involving mazes or other artificial structures are permitted if the effects of the structure are not stressful to the animal.
- Studies involving pain.

- Live predator/prey experiments (simulations are allowed).

Microorganisms

Related Protocol Forms:

- High School: [ISEF 6A: Potentially Hazardous Biological Agents Form](#)
- Middle School: Protocol Form for Research Involving Hazardous Biological Substances (Grades 6-8)

Students are prohibited from cultivating microorganisms at home.

- Microorganisms include, but are not limited to, bacteria, fungi (including molds and yeast), and viruses.
- Middle Division (Grades 6-8) participants are allowed to *collect* microorganisms of unknown origin from the environment (e.g., swabbing common surfaces, skin, soil). Cultures can be collected if they are immediately sealed and transported to an approved experimental location.
- *These rules do not apply to projects involving composting or decomposition of foods if projects are terminated at the first sign of microbial growth.*

Experiments that involve cultures of known Biosafety Level 1 microorganisms or of unknown origin from swabbing must be:

- Cultured in plates that are sealed with parafilm or placed in two heavy-duty sealed plastic bags;
- Disposed under the direct guidance of the designated supervisor while wearing a lab coat and disposable gloves and using any of the following aseptic techniques: autoclaving at 121°C for 20 minutes, soaking in 10% bleach solution for 10 minutes, or incinerating.

Biological Tissues

Related Protocol Forms:

- High School: [ISEF Form 6B: Human and Vertebrate Animal Tissue Form](#) (must also complete Form 6A)
- Middle School: Protocol Form for Research Involving Hazardous Biological Substances (Grades 6-8)

Due to the safety risks associated with handling potentially hazardous biological agents, proposals for projects that involve human or vertebrate tissue/fluids must be reviewed and approved by the school fair SRC **prior** to experimentation.

Middle (Grades 6–8) Division students are allowed to conduct experiments with human or vertebrate tissues that are:

- Meat or meat products from a store or restaurant treated to inhibit bacterial growth, naturally shed or cut hair, fossilized tissues, and sterilized teeth.
- Student’s own bodily tissues, if the experimental proposal is pre-approved by the school fair SRC and tissues are treated as BSL-1 biohazard; and
- Tissues from a biological supply house/catalog, hospital, or certified doctor/laboratory as long as the proposal is pre-approved by the school fair SRC and the tissues are treated as [Biosafety Level 2](#) biohazard.

Resources on Safety in Experimentation

- Human as Research Participants
 - [Society for Science Human Participants](#)

- [Penslar, R.L.,\(1993\). Institutional Review Board \(IRB\) Guidebook. Washington, DC.: ORRP-NIH](#)
- Animals as Test Subjects
 - [Society for Science Vertebrate Animals](#)
 - [Guide for the Care and Use of Laboratory Animals \(8th edition\). The National Academies Press](#)
- Hazardous Biological Agents
 - [Society for Science Potentially Hazardous Biological Agents](#)

Categories and Topic Descriptions

Category Name and Abbreviations	Topic Descriptions
Animal Sciences (AS)	genetics, physiology, pathology, and systematics
Behavioral and Social Sciences (BE)	human clinical and developmental psychology, cognitive physiological psychology, and sociology
Biochemistry (BI)	chemical processes within and relating to living organisms
Chemistry (CH)	analytical chemistry, inorganic chemistry, organic chemistry, and physical chemistry
Computational Biology and Bioinformatics (CB)	computational biomodelling, epidemiology, evolutionary biology, neuroscience, pharmacology, and genomics
Computer Science (CS)	algorithms/data bases, networking and communications, graphics, virtual reality, operating systems, and software engineering
Earth and Planetary Sciences (EP)	climatology, weather, geochemistry, mineralogy, tectonics, paleontology, and geophysics
Engineering (EN)	civil, constructional, chemical, industrial, electrical, computer, and mechanical engineering, materials sciences, bioengineering
Environmental Sciences (EV)	air, soil, and water pollution/quality, bioremediation, environmental engineering, land resource management, recycling, and waste management
Materials Sciences (MS)	product testing, product development (biomaterials, ceramic and glasses, composite materials, computation and theory, electronic, optical, and magnetic materials, nanomaterials, polymers)
Mathematics (MA)	probability and statistics, and applied mathematics
Medicine & Health Sciences (MH)	disease diagnosis and treatment, epidemiology, human genetics, and pathophysiology
Microbiology (MI)	bacteriology, virology, and microbial studies
Physics (PH)	Newtonian physics, instrumentation and electronics, nuclear and particle physics, optics/lasers, and theoretical physics
Plant Sciences (PS)	agriculture, agronomy, horticulture, forestry, plant taxonomy and evolution, plant physiology, plant pathology, and plant genetics
Robotics and Intelligent Machines (RI)	Biomechanics, cognitive systems, control theory, machine learning, and robot kinematics

Phase I: “Virtual Judging”

Middle Division

- All students must register and submit forms and projects in zFairs February 23, 2024, at 4 p.m. See your science fair coordinator for support with this process.
- For a PWCS student to create an account in zFairs, parent consent must be obtained per the PWCS regulations:
 - Parents will be given a link to the Parent Consent Form from their science fair coordinator to initiate zFair registration.
 - After parents complete the form, they will receive an email containing the registration link. It is the parents’ responsibility to provide this registration link to their student.
- Non-PWCS students will receive the zFairs’ registration link from their school science fair coordinator.
- Team Projects: All members of the team must register in zFairs. The first team member to register should indicate that they are part of a team project. That team member will receive a “Project Key” code to be shared with their teammates. The other teammates will use the “Project Key” code to link their account to the team. A short video on this process can be found on zFairs’ home page.

Protocol Forms

- Our policies are aligned with ISEF to ensure compliance and consistency at all levels. Projects that do not adhere to the safety/sanitation guidelines will be disqualified.
- Middle School protocol forms must be approved before experimentation can begin.

Project Components

- PowerPoint (PPT) presentation of up to 10 slides must be uploaded as a PDF (File sizes cannot exceed 10 MB; we strongly recommend you save it and [compress](#) if needed).
- Video presentation of the PPT slides (no more than 3 minutes, shared via public link that summarizes your project.)
- A series of short videos are available on zFairs student page to support you in this process.

Senior Division

- All students must register and submit forms and projects in zFairs February 23, 2024, at 4 p.m.
- For a PWCS student to create an account in zFairs, parent consent must be obtained per the PWCS regulations:
 - Parents will be given a link to the Parent Consent Form from their science fair coordinator to initiate zFair registration.
 - After parents complete the form, they will receive an email containing the registration link. It is the parents’ responsibility to provide this registration link to their student.
 - During registration students must submit ISEF forms.

Note: This process had to be completed prior to a student beginning their research.

- Team Projects: All members of the team must register in zFairs. The first team member to register should indicate that they are part of a team project. That team member will receive a “Project Key” code to be shared with their teammates. The other teammates will use the “Project Key” code to link their account to the team. A short video on this process can be found on zFairs home page.

Protocol Forms

- PW-MRSEF policies are aligned with ISEF to ensure compliance and consistency at all levels. Projects that do not adhere to the safety/sanitation guidelines will be disqualified.
- ISEF protocol forms must have been approved by your School Science Fair Coordinator/IRB/SRC before experimentation begins.
- Check with your school's science fair coordinator to ensure that your project has been "promoted" to the regional fair and that the approved ISEF forms are viewable in zFairs.
- Project Components to submit to zFairs:
 - ISEF forms
 - [Abstract](#)
 - [Quad Chart](#)
 - PowerPoint presentation uploaded as a PDF (no more than 12 slides but less than 10 MB; we strongly recommend you save it and [compress](#) if needed)
 - Video presentation of the project (no more than 2 minutes, shared via public link)

Phase II: "In-Person" Project Components

Students will present their projects in-person, and judges will have an opportunity to ask questions.

- Total time: about 10 minutes per project.
- Judges may decide to return for additional evaluation after their initial deliberation.

To support their live presentation, students have two options, which include:

- Create a traditional display (i.e., tri-fold board; see Project Dimension Guidelines, page 13)
- Bring a fully charged personal device and use either the PPT or the Quad Chart to guide the presentation.

Items Prohibited at a Project Display

All project displays will be inspected for prohibited items before judging begins. Prohibited items will be removed.

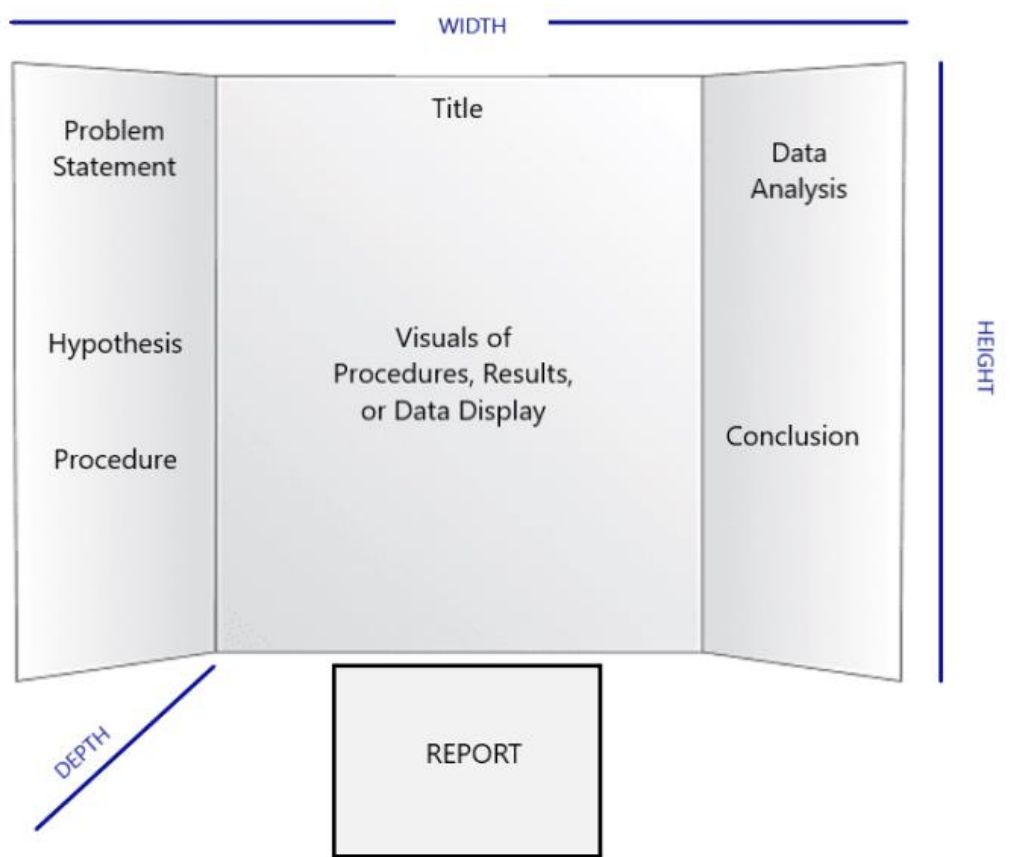
- Personal information is not allowed to be displayed on any display components (boards, PPT video, etc.). This includes the last names of students, name of teacher, and school.
- Human and animal food may not be displayed in your project area. Photographs are suitable representations.
- Microbial cultures (live or dead) are prohibited from display. Photographs are suitable representations.
- Bare wires or knife switches may be used on circuits of 12 volts or less; otherwise, standard enclosed switches, conforming to safety codes, are required.
- Vertebrate organisms or their parts may not be displayed. Exception: microscope slides acquired from biological supply companies and labeled as to their origin.
- All chemicals (including water) and their containers are prohibited. Exception: water in an enclosed apparatus.
- Dry ice or other sublimating solids are prohibited.
- Flames or highly combustible materials are prohibited.
- Glass (except microscope slides)
- Plants:
 - Students in Grades 9–12 are not permitted to display plants, per the ISEF guidelines

- Students in Grades 6–8 are permitted to display plants.

Project Dimension Guidelines

Students who opt for a traditional display (cardboard tri-fold boards) are responsible for ensuring that their display items fit within the maximum dimensions identified below.

Middle Division	Senior Division
<ul style="list-style-type: none"> • Depth: 38 cm (15 in.) • Width: 91 cm (36 in.) • Height: 274 cm (108 in.) 	<ul style="list-style-type: none"> • Depth: 76 cm (30 in.) • Width: 122 cm (48 in.) • Height: 274 cm (108 in.)

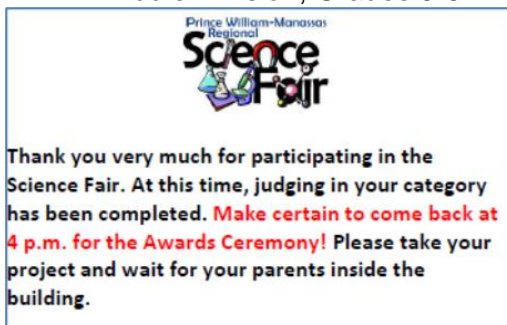


<input checked="" type="checkbox"/> Accepted	<input type="checkbox"/> Not Permitted
Displays that stand on their own and fit the dimensions above.	Student, teacher, or school names.
Use of video and/or photographs.	Use of electrical outlets and extension cords.

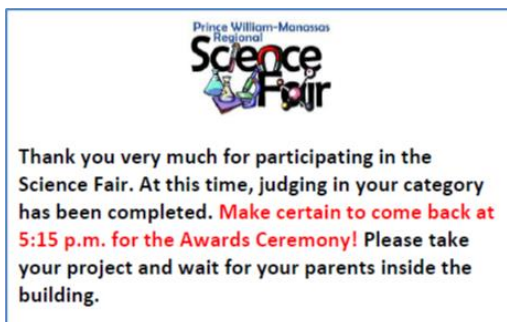
In-Person Event Procedures

- The fair is an all-day event.
- Please do not request special judging, as we cannot honor such requests.
- The project area will be open at 8:00 a.m. You must be with your project no later than 8:50 a.m.
- Only participants are permitted in the judging area after 8:50 a.m. Family members may wait for you in the lobby, but please note that space is very limited. We suggest that parents and guardians do not stay and that you call or text them once your category is dismissed, should the judging finish before noon.
- Judging times vary by category. Chairs are provided, but standing is expected when conversing with judges.
- Remember to bring reading materials, schoolwork, a snack, and a drink to the judging area. Food is not available for purchase. Use headphones for any audio unrelated to your project presentation. Personal devices can access wireless on the PWCS-Guest network.
- You will be given a dismissal card, shown below, to indicate that judging in your category is complete. You must leave the judging area at this time. Please remember to take your project with you.

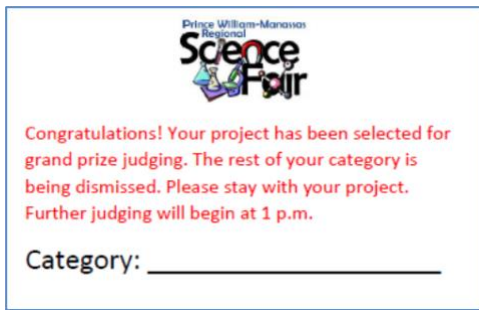
Middle Division, Grades 6-8



Senior Division, Grades 9-12



- Senior Division only: If you are asked to remain with your project after everyone else in your category has been released, you will be given the card below. This means your project has qualified for grand-prize judging. A cheese pizza lunch will be provided for students invited to stay for grand prize judging. Please bring a bag lunch if this does not meet your dietary needs.



- Parents: We will use a dismissal board in the lobby to indicate which categories have been dismissed. Students must take their projects and leave the judging area when dismissed. Parents are asked to meet their students outside the judging area but inside the KLC lobby. Students and parents must then exit the building together.
- The KLC will be closed to the public from 3-4 p.m.
- We encourage all participants to return to the KLC for the awards ceremony for the recognition of organizational awards, honorable mentions, and third, second, first place, and grand prize winners in each category.
 - Middle School Division (Grades 6-8): 4 p.m.
 - Senior Division (Grades 9-12): 5:15 p.m.

Preparing for Your Interviews

To help you prepare for the interview portion of the event, Appendix B has some possible questions that you may be asked. Judges are not limited to these questions and may ask others. Preparing for these questions should prepare you to speak about your investigation.

Project Awards and Recognition of Merit

There are two major types of awards presented to students at science fairs: category awards and organizational awards.

Category Awards

- Participants submit their projects in one of the 16 categories listed on page 10. Judges evaluate projects using criteria described in Appendix A.
- All participants will receive a certificate of regional fair participation.
- Judges may award one first, second, and third place and up to three “honorable mentions” in each category. All winners will receive a medal, each a different color signifying the awarded place; first-place projects in each category will also be presented with a trophy.
- Senior Division:
 - The first and second-place winners in each senior division category will qualify to compete in the [Virginia State Science and Engineering Fair \(VSSEF\)](#).
 - Grand prize winners will represent the PW-MRSEF at the [International Science and Engineering Fair \(ISEF\)](#).
- Middle Division:
 - The first-place winners of the middle division regional fair are eligible to participate in the [Thermo-Fisher Scientific Junior Innovators Challenge](#) national competition.

Organization Awards

- There are various ways organizations and sponsors can recognize students at the PW-MRSEF for their research efforts in science and engineering.
- Over 30 organizations awarded 200+ student prizes in the 2023 PW-MRSEF.
- National and local science and engineering organizations will judge student projects according to their unique criteria to recognize exemplary research projects in specific career fields. For example, an organization may seek research conducted in geoscience, including physics or earth science projects.
- Organizations will use their judges and provide student awards: which **may** include certificates, invitations to an organization’s banquet, monetary awards, medals, or ribbons, etc.
- To qualify for an organizational award, parents must complete the media release and hold harmless forms in zFairs so that organizations can be provided with contact information. The organization sponsors will directly contact the participant that they select as winners.

Appendix A: Judging Criteria

Middle Division (Grades 6-8) Science Projects

Criterion	Description	Maximum Points
Experimental Design	The experimental process: <ul style="list-style-type: none"> • Research Question • Literature Review • Hypothesis • Independent Variable • Dependent Variable • Constants • Control 	35
Materials & Procedures	List of materials Procedures	10
Results*	Data Tables Graphs Written Explanation	15
Conclusion	Summary of results/data Sources of error New learnings or questions	10
Creativity*	Innovation and quality of ideas	20
Presentation	<ul style="list-style-type: none"> • Understanding basic science relevant to the project • Proper interpretation of results • Recognition of limitations of results • Clarity of presentation • For team projects: contributions to and understanding of project by all team members 	10
	TOTAL	100

Note. Considerable emphasis is placed on the criteria marked with asterisks (*).

Middle Division (Grades 6-8) Engineering Projects

Criterion	Description	Maximum Points
Research Problem	<ul style="list-style-type: none"> • Description of a practical need or problem to be solved • Definition of criteria for proposed solution • Explanation of constraints 	20
Design and Methodology	<ul style="list-style-type: none"> • Alternative solutions were explored • Identification of a solution • Development of a prototype/model 	30
Execution: Construction and Testing*	<ul style="list-style-type: none"> • Prototype demonstrates intended design • Prototype has been tested in multiple conditions/trials • Prototype demonstrates completeness 	25
Creativity*	<ul style="list-style-type: none"> • Project demonstrates significant creativity in one or more of the above criteria 	15
Presentation	<ul style="list-style-type: none"> • Understanding basic engineering relevant to the project, proper interpretation, and recognition of limitations of design, clarity of presentation. • For team projects: contributions to and understanding of project by all members 	10
	TOTAL	100

Note. Considerable emphasis is placed on the criteria marked with asterisks (*).

Senior Division (Grades 9-12) Science Projects

The point system and criteria are established by the International Science and Engineering Fair (ISEF)

Criterion	Description	Maximum Points
Research Question	<ul style="list-style-type: none"> • Clear and focused purpose • Identifies contribution to the field of study • Testable using science methods 	10
Design and Methodology	<ul style="list-style-type: none"> • Well-designed plan and data collection methods • Variables and controls defined, appropriate and complete 	15
Execution: Data Collection, Analysis, and Interpretation	<ul style="list-style-type: none"> • Systematic data collection and analysis • Reproducibility of results • Appropriate application of mathematical and statistics methods • Sufficient data collected to support interpretation and conclusions 	20
Creativity*	<ul style="list-style-type: none"> • Project demonstrates significant creativity in one or more of the above criteria 	20
Presentation*	<ul style="list-style-type: none"> • Clear, concise, thoughtful communication • Understanding of basic science relevant to project • Understanding interpretation and limitations of results and conclusions • Degree of independence in conducting project • Recognition of potential impact in science, society, and/or economics • Quality of ideas for further research • For team projects: contributions to and understanding of project by all members 	35
	TOTAL	100

Note. Considerable emphasis is placed on the criteria marked with asterisks (*).

Senior Division (Grades 9-12) Engineering Projects

The point system and criteria are established by the International Science and Engineering Fair (ISEF)

Criterion	Description	Maximum Points
Research Problem	<ul style="list-style-type: none"> • Description of a practical need or problem to be solved • Definition of criteria for proposed solution • Explanation of constraints 	10
Design and Methodology	<ul style="list-style-type: none"> • Exploration of alternatives to answer need or problem • Identification of a solution • Development of a prototype/model 	15
Execution: Construction and Testing	<ul style="list-style-type: none"> • Prototype demonstrates intended design • Prototype has been tested in multiple conditions/trials • Prototype demonstrates engineering skill and completeness 	20
Creativity*	<ul style="list-style-type: none"> • Project demonstrates significant creativity in one or more of the above criteria 	20
Presentation*	<ul style="list-style-type: none"> • Logical organization of material • Clarity of graphics and legends • Understanding of basic science relevant to project • Understanding interpretation and limitations of results and conclusions • Degree of independence in conducting project • Recognition of potential impact in science, society, and/or economics • Quality of ideas for further research • For team projects, contributions to and understanding of project by all members 	35
	TOTAL	100

Note. Considerable emphasis is placed on the criteria marked with asterisks (*).

Appendix B: Possible Questions for Student Interviews

Judges are not limited to asking these questions, but practicing may help you prepare for the interview.

Background Knowledge

Middle Division	Senior Division
Tell me about your project. Why did you decide on this research?	Tell me about your project. Can you explain the theoretical framework that supports your research?
What was the purpose of your project?	How does your project fit into the larger context of your field of interest?
What resource did you find that was helpful? Why?	What literature or prior research informed your project?
How did you come up with your hypothesis?	What inspired you to choose this topic?

Experimental Design

Middle Division	Senior Division
What was your hypothesis?	Are there any limitations or biases in your methodology that you are aware of?
What variable did you intentionally change? What response did you observe or measure? What did you intentionally keep the same?	Did you consider any alternative hypotheses or interpretations?
What group did you compare against the others? Why? How many times did you repeat the experiment?	Can you identify the most critical variables in your experiment or project?
Did you encounter any surprises or challenges while conducting your research? How did you overcome them?	How would you scale this project if given more resources?

Materials and Procedures

Middle Division	Senior Division
What materials did you use?	What kind of data analytics or statistical methods did you use to interpret your results?
What steps did you follow in conducting the experiment?	Have you thought about the long-term sustainability of your project or research?
If you had a mentor, in what ways did the mentor assist you?	How do you plan to address the challenges or limitations you have encountered?

Results/Conclusion

Middle Division	Senior Division
What were the results of your experiment? Can you explain this chart to me?	How would you improve upon your current research if you had more time or resources?

How did the results relate to your original hypothesis? What conclusions did you make?	How do you think your project could influence policy or decision-making in the field?
If you conducted the experiment again, what would you do differently? What additional experiments would you suggest?	Are there any ethical or societal implications to your findings?
What was the most important thing you learned from the experiment?	How has this project influenced your future career goals or academic interests?
Did something unexpected happen during the investigation? What did you do?	Did you encounter any difficulties or setbacks during the investigation? How did you handle the situation?
If you were going to do this project again, what might you do differently?	If you were going to do this project again, what might you do differently?
What was your favorite part of the project?	Were any of your results unexpected?

Engineering Specific Question

Middle/Senior Division
Tell me about your project.
Why did you choose your project topic?
What problem does your project solve?
What resources did you use before building your prototype?
What alternative solutions did you explore?
How did you test your prototype? And how many times?
What was the most challenging part of the project?
What practical application do you see for this project?

Sources:

Cothron, Giese, & Rezba. Students and Research, Kendall/Hunt, 1989.

OpenAI. (2023). ChatGPT (August 3 Version) [Large language model]. <https://chat.openai.com>

Appendix C: Middle School Protocol Forms



Protocol Form for Research Involving Hazardous Biological Substances (Grades 6-8)

Attention: Certain hazardous biological materials are prohibited at PWCS.

(Please check with your teacher or school fair coordinator before completing this form.)

Directions. Complete this form electronically, print a copy, have your teacher review and sign. Then give the form to your school fair coordinator.

Participants Name: _____

Grade/School: _____

Project Category: _____

1. Specify microorganisms (yeast, mold, or probiotic bacterial cultures) or biological tissues (urine, blood, muscle, bone, etc.) that you plan to use and explain why they are proposed for this work.
2. Describe potential risks involved and personal protective measures to be followed.
3. What is the source of your biological tissues or microorganisms?
4. Describe disposal procedures.
5. What is the potential benefit or practical application of this research?

Teacher Approval **Before** Research

My review of this project plan indicates that the student understands the proper techniques for working with the biological agents identified on this form, and the risks are reasonable for research to be conducted at the middle school level.

Teacher/Supervisor Name (Please Print)

Teacher/Supervisor (Signature)

School Fair Coordinator: _____



Protocol Form for Research Involving Hazardous Chemical Substances, Activities, or Devices (Grades 6-8)

Attention: Certain chemical materials are prohibited or have restricted use at PWCS.

(Please check with your teacher or school fair coordinator before completing this form.)

Directions. Complete this form electronically, print a copy, have your teacher review and sign. Then give the form to your school fair coordinator.

Participants Name: _____

Grade/School: _____

Project Category: _____

1. Provide a list of chemicals, activities, devices, and explain why they are proposed for this research.

2. Describe potential risks and protective measures to be followed, including disposal.

3. Are any of them restricted at Prince William County Public School per the *Science Education Safety Plan*? (If yes, list the name of each substance and the amount that will be used).

4. What is the potential benefit or practical application of this research?

Teacher Approval **Before** Research

My review of this project plan indicates that:

- a) no prohibited substances will be used for this research and
- b) the risks are properly recognized and deemed as reasonable for a study to be conducted at the middle school level.

Teacher/Supervisor Name (Please Print)

Teacher/Supervisor (Signature)

School Fair Coordinator: _____



Protocol Form for Research Involving Human Participants (Grades 6-8)

A sample of your "Informed Consent" must be attached to this form.

(Refer to [Human Participants - Society for Science](#) and consult with your teacher or fair coordinator)

Directions. Complete this form electronically, print a copy, have your teacher, nurse, and administrator review and sign, and then turn in the form to your school fair coordinator.

Participants Name: _____

Grade/School: _____

Project Category: _____

1. Explain why human participants are necessary for this research.
2. Describe potential risks (physical, psychological, or legal) to participants and how these risks will be addressed.
3. How will humans be provided with the "Informed Consent" form and indicate their **voluntary** agreement? **If minors**, how will the parental consent be obtained?
4. What is the potential benefit or practical application of this research?

Institutional Review Board (IRB) Approval **before** Research

My review of this project plan indicates that a) no personal identification data will be collected during this research, and b) there are no or minimal risks for the human participants of this study.

Teacher/Supervisor Name (Please Print)

(Signature)

Nurse Name (Please Print)

(Signature)

Administrator Name (Please Print)

(Signature)

School Fair Coordinator: _____



Protocol Form for Research Involving Vertebrate Animals (Grades 6-8)

(Please check with your teacher or school fair coordinator before completing this form.)

Directions. Complete this form electronically, print a copy, have your teacher review and sign. Then give the form to your school fair coordinator.

Participants Name: _____

Grade/School: _____

Project Category: _____

1. Explain why a vertebrate animal is necessary for this research.
2. Describe potential risks (physical, psychological, or legal) to the animal and how these risks will be addressed.
3. Describe potential risks to the human(s) working with the animal and how these risks will be addressed.
4. Describe animal care procedures for this experimentation.
5. What is the potential benefit or practical application of this research?

Teacher Approval **Before** Research

My review of this project plan indicates that there are no risks to the human(s) and the animal(s), or the risks are reasonable for the study to be conducted at the middle school level and will be properly mitigated.

Teacher/Supervisor Name (Please Print)

Teacher/Supervisor (Signature)

School Fair Coordinator: _____