Student and Teacher

Science & Engineering Fair Handbook

for

Experimental & Engineering Projects

Intermediate (Grades 4 - 6) &
Junior (Grades 7 - 8) Divisions

Science & Engineering Fair Guide
Grades 4-7

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I. INTRODUCTION

Congratulations! You are about to take the first step in preparing a project eligible to compete with over 1,100 other projects from the Greater KC Metro area at this year's Greater Kansas City Science & Engineering Fair (GKCSEF). Presented by Science City and supported by local businesses and individuals interested in promoting STEM, the fair offers you the opportunity to compete for almost 300 in prizes and awards.

II. GENERAL INFORMATION

ORGANIZATION OF THE FAIR

The Fair is organized by Grade Level and Category.

GRADE LEVELS

There are three Grade Divisions:

- Intermediate 4^{th}, 5^{th} and 6^{th} grades
- Junior 7^{th} and 8^{th} grades
- Senior 9^{th}, 10^{th}, 11^{th} and 12^{th} grades

The categories are as follows:

Animal Science (AS): Study of animals, their life cycles, anatomy, and classification; physiology; animal husbandry; entomology; ichthyology; ornithology; herpetology; mammalogy; development; nutrition and growth; animal Mendelian genetics; ecology; systematics and evolution.

Behavioral and Social Sciences (BE): Study of human and animal behavior; social and community relationships; psychology (cognitive, physiological, and social); sociology; anthropology; linguistics; learning; perception; reading problems; educational testing; social media dynamics.

Chemistry (CH): Study of the composition, structure, properties, and reactions of matter. Includes all forms of chemistry investigations – analytical; environmental; computational; inorganic; organic; materials; physical; and nanomaterials.

Chemical Energy (CE): Alternative fuels; fossil fuel energy, fuel cells and battery development; microbial fuel cells (also **MI**); solar materials; fluid and gas dynamics; thermodynamics; remediation; waste management; chemical pollution.

Computational Science, Bioinformatics and Mathematics (CM): *Applications of computers to analyze a particular problem – see **CS** below for computer systems*. **Biological applications of computers:** biomedical engineering; various computer applications, including pharmacology, biomodeling, bioinformatics; evolutionary biology; neuroscience, and genomics. **Mathematics:** the study of measurement; properties and relationships of quantities and sets; using numbers and symbols; deductive study of numbers, geometry, various abstract constructs, sets or structures; algebra analysis; combinatorics; graph theory; game theory; topology; number theory; probability and statistics.

Computer Systems, Electronics, Robotics (CS): Computers include: the study of information processes including structures, process procedures, and implementation of processing systems; systems analysis and design; data analysis; network design and operations; application and system software design; programming; data center operations; networking and data communications; algorithms. **Electronics:** circuits; microcontrollers; integrated optics; sensors; signal processing; energy conservation. **Robotics**: biomechanics; cognitive systems; control theory; machine learning (includes AI); robotic kinematics; algorithms; databases; operating systems; programming languages.

Earth and Environmental Sciences (EA): ***EA*** *differs from **EE** by measuring/monitoring these areas, not applying a solution to problem.* **Earth Science:** the study of science related to plant earth to include geosciences; mineralogy; water science; physiography; oceanography; meteorology; speleology; seismology; geography. **Ecology**: populations, communities; ecosystems. **Environmental Science** *defined Man's interaction with the ecosystem*: climatology; atmospheric science; environmental effects on ecosystems; geosciences, (mining, fracking etc.); water sciences (aquifers, pollution); recycling; waste management; water resources management.

Energy and Environmental Engineering (EE): Energy: solar; Power including hydro, nuclear, solar, thermal, geothermal, wind; sustainable design; renewable energies – also includes the theories, principles and laws governing energy and the effect of energy on matter – solid state; optics; acoustics; particle; nuclear; atomic; plasma; superconductivity; fluid and gas dynamics; thermodynamics; semiconductors; magnetism; quantum mechanics; biophysics. **Environmental Engineering:** ***EE*** *differs from **EA** by applying science to solve a problem* and includes bioremediation, land reclamation, pollution control, recycling and waste management; water resources management.

Engineering Mechanics (EM): Engineering including aerospace and aeronautical, civil, mechanical; computational mechanics; control theory; ground vehicle systems; industrial engineering-processing; naval systems; space travel equipment such as rockets, etc.

Materials Science (MS): Biomaterials; ceramics and glasses; composite materials; computation and theory (as applied to materials) electronic materials; optical materials; magnetic materials; nanomaterials; polymers; plastics.

Microbiology (MI): Antimicrobials; antibiotics; bacteriology; applied microbiology; environmental microbiology; microbial genetics; virology; prions; study of prokaryotic cell processes and organelles.

Molecular Bio/Chem & Health Sciences (MO): Study of vital processes occurring in living macromolecular systems (Eukaryotic) including the processes by which these substances enter into, or are formed in the organisms (chemically and/or genetically), and/or react with each

other and the environment; biochemistry (analytical, medicinal, structural); disease diagnostics and treatment: drug development and testing; epidemiology; nutrition; physiology; pathology; cell physiology; eukaryotic genetics; immunology; neurobiology; pathophysiology.
Physics and Astronomy (PA): Physics: atomic, molecular, optical, biological, computational, nuclear and particle physics, theoretical; condensed matter and materials; instrumentation; magnetics – electromagnetic and plasmas; mechanics; optics, lasers, and masers.
Astronomy: Anything in the universe beyond Earth such as the positions, dimensions, distribution, motion, composition, energy, and evolution of celestial bodies and related phenomena; astronomy; cosmology; computational astrophysics.
Plant Science (PS): Study of plants and their life cycles; structure; growth; macro processes, classification; evolution; agronomy; macro genetics; development; pathology; physiology; organics; GMO's; taxonomy; ecology; hydroponics.
Inventions (NV): (Grades 4-8 only) Creation or modification of devices or processes that solve or alleviate challenges in our lives.

Students may enter a project individually or as part of a team of no more than **3 students.**

III. PRE-PROJECT PLANNING

Please read this section carefully before you begin any experimentation relating to your project.

All students from schools that do not have science fairs can enter as a single individual or group. To be allowed to do so students must fill out this form and submit to Fair Team for prior approval:

Prior Approval to Enter as an Individual or Team (non-school sponsored)

The Greater Kansas City Science & Engineering Fair (GKCSEF) is an affiliate of the International Science & Engineering Fair (ISEF). ISEF has developed (following strict national scientific and educational guidelines) a set of regulation forms that must be signed prior to experimentation.

Students in grades 4-8 are not required to use the regulation forms unless they have designed a project using human subjects, human cells, tissue, teeth, organs, or body fluid.

All Intermediate and Junior Projects using human or animal tissue, including blood, blood products, teeth, primary cell cultures, & body fluids must have:

Human or Animal Tissue Form (1) (must be signed by Science Review Committee (SRC)- See form)

All Intermediate and Junior Projects that use human subjects (including the student doing the experiment) must include:

Human Participant Form (2) – turned into the Science Fair Team at Fair. A signed copy must be uploaded to STEM Wizard for approval.

All Intermediate and Junior Projects that involve hazardous materials must include:

Hazardous Materials Form (3) (must be signed by Science Review Committee (SRC)- See form)

All Intermediate and Junior Projects that involve bacteria must include:

Bacteria Form (4) (must be signed by Science Review Committee (SRC) – See form)

Projects not following proper protocol as described by ISEF will be disqualified.

Student projects in grades 4-8 using vertebrate animals will be disqualified except for observational studies. Also, firearms, explosive devices, or hazardous chemicals are not allowed.

As you plan your project for the Greater Kansas City Science & Engineering Fair you should:

- Read this booklet carefully
- **Do Not** start your experimentation until you fill out and have signed all necessary forms
- Begin your project early in the school year
- Seek Help, Contact GKCSEF Team if you have any questions.

We have several programs that are geared specifically to helping teachers and students with entering the GKCSEF. Check the website for dates and times of these events.

Teachers:

Mentor Directory—a resource for locating mentors for students on science and engineering projects is available to teachers who request a copy. You may request a copy by calling 816-460-2261 or ssullivan@unionstation.org.

Students and Teachers:

Saturday STEM Seminars— offer timely topics for people seeking enrichment and extended STEM knowledge. Seminars run 9-10 am on various Saturdays throughout the school year.

Please check www.sciencecity.com/education for details and dates of all events.

IV. FAIR RULES and REGULATIONS

GENERAL RULES

1. The following types of projects are **NOT** permitted in the Fair:

   - **Projects that are demonstrations, models, collections or reports.**
   - Projects that use only qualitative or subjective data. Data collected for all experimental projects must be measurable (quantitative or objective). Surveys and opinion polls are unacceptable.
   - Projects that demonstrate scientific principles that are already common knowledge (green plants need visible light to grow, magnets attract iron, batteries can make a light bulb glow, etc.)

2. Projects that involve **product testing** are discouraged, but may be entered by 4^{th} – 9^{th} graders if they comply with the following criteria, which are intended to make the experiment truly scientific:

   (Product testing is defined as an experiment in which a group of various commercially available products are compared against each other to test their ability to perform a function of that product. Comparing how white clothes get using different laundry detergents, timing how long different brands of batteries can light a bulb, testing how bacteria stand up to mouthwash, and counting the number of popcorn kernels that did not pop are all examples of **product testing**.)

   - A well formulated hypothesis must be clearly stated and tested by the experiment.
   - Dependent and independent variables must be clearly and correctly identified in the abstract and write-up.
   - There must be <u>at least</u> 10 tests of each variable.
   - Data must be quantifiable on some identified scale or comparison. The scale can be created by the student. For example, whiteness can be compared to a set of paint chips ranging from relative values of 1 for white to 8 for light beige. No opinion based results will be accepted.
   - Data must be presented using graphs or charts which demonstrate that the hypothesis was tested, and the conclusions drawn are reasonable given the data.

3. Any exhibit that has been previously entered in the Greater Kansas City Science & Engineering Fair may not be reentered in the competition.

4. You may not enter more than one project in the fair.

5. Your exhibit dimensions are not to exceed the following:

   Grades 7-8: Maximum size is 76cm (30") deep X 122cm (48") wide
   Grades 4-6: Maximum size is 76cm (30") deep X 81cm (32") wide.

6. Your exhibit must be completely self-contained and self-supporting. Note that the display board should be sturdy enough to withstand wind currents present in the exhibit hall.

7. **All unclaimed projects by 7pm on tear down day are disposed of as part of the fair dismantling**. **Science City at Union Station DOES NOT keep any projects.**

8. **Do not place valuables or sensitive equipment as part of a display.** Science City is not responsible for stolen or damaged equipment or other valuables.

SAFETY RULES

1. All electrical equipment must be constructed according to standard electrical safety laws. Exhibits requiring electrical current for operation or illumination must be designed for operation on alternating current at 110 volts. If batteries are used, they should be storage batteries to ensure continuity of operation.

2. Ordinary doorbell push buttons and open knife switches may not be used to control 110-volt apparatus. Only suitably rated UL 110 volt toggle or push button type switches, mounted on panels or switch boxes are allowed.

3. All wiring, switches and metal parts carrying 110 volt current must be grounded properly and out of reach of visitors.

4. All electrical points must be soldered and taped properly (following UL regulations.)

5. Nails, tacks and un-insulated staples may not be used for fastening wires. Use porcelain or other approved types of insulators.

6. All wiring must be **properly insulated** for voltage used.

7. Dangerous chemicals in open containers, open flames, flammable liquids and explosives are strictly prohibited.

8. If bacteria are displayed, they must be in **sealed** containers.

9. No live animals, vertebrate or invertebrate, are to be displayed at the Fair.

NOTE: THE SCIENCE REVIEW COMMITTEE(SRC) RESERVES THE RIGHT TO INSPECT AND DISQUALIFY ANY EXHIBIT THAT DOES NOT CONFORM TO THE RULES AND REGULATIONS IN THIS BOOKLET.

V. ENTERING THE FAIR

NUMBER OF ENTRIES PER SCHOOL

Each school is allotted 20 entries per division (ex. Intermediate, Junior or Senior). However, if the school has more than 20 **QUALITY** projects, they may contact the Fair Director (emeyer@unionstation.org) to request permission to bring more. The total number of entries may be in any combination of categories.

REGISTRATION

1. GKCSEF Registration are now ONLINE at https://sciencecitygkcsef.stemwizard.com/public_site/home/sciencecitygkcsef.

2. Online Registration should be completed **no later than the deadline date at 5:00 pm.**

3. All Registrations should be completed and accompanied by the **fee and a copy of all required forms.**

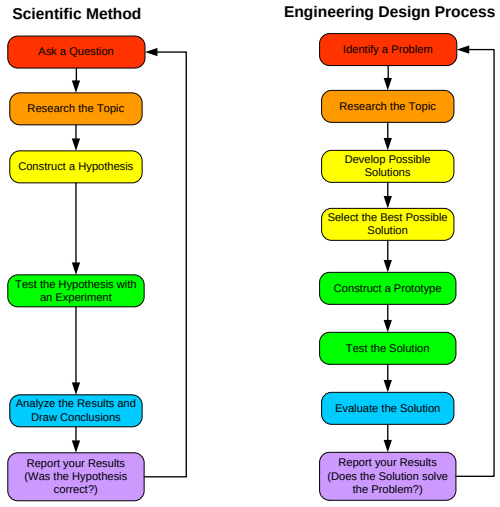
   - Be sure to have all certification forms filled out and signed by the appropriate people (e.g., teacher/sponsor, parent, etc.) ***before*** you begin experimentation.

   - **REGISTRATIONS received without the proper forms attached will be disqualified.**

   - All applications should include:
     a. An adequate abstract (experimental) or description (engineering). The description of the project provided with Registration is the only means the review committee has to evaluate and classify your project.
     b. A clear description of the problem.
     c. The type of data collected (experimental) or testing done (engineering).

For detailed information on how to enter an Invention project, please refer to *The Inventor's Handbook*. This is a free publication available on our website at www.sciencecity.com/education

4. Engineering Projects: Not all areas of study are best served by scientific method based research. Engineers sometimes have different objectives than those of other sciences; they follow a different process in their work. Use the flowcharts below to see how the Scientific Method differs from the Engineering Design Process. You may use whichever method best fits your project.



See scoring guides on the website to check criteria for judging.

5. All entry forms will be reviewed within two weeks of the final deadline. Any registrations not complying with the rules and regulations set forth in this booklet, the teacher will be notified with a written explanation.

Teachers: If any applications are disqualified, please advise your students as soon as possible.

VI. SETTING UP AT THE FAIR

1. For detailed information regarding dates and times of this year's fair, please refer to the Science Fair schedule on the website at **www.GKCSEFScienceCity.stemwizard.org**.

2. The student, parent or teacher can set up the project between 8am and 3pm on set up date. **(Note: project set-up requires approximately 15-20 minutes.)**

3. When setting up your project, you must bring:

- Your paper
- Any required forms
- Display board and any accessories or models
- The project number sent to you by GKCSEF Fair team. You may include your project number on your board and paper. This number identifies the placement of your project. Maps will be at the entrance and fair booth for your assistance. **Please ensure that your project number exactly matches your table location.**

VII. JUDGING and AWARDS

Each project is reviewed by two judges:

Academic Judges evaluate each project based on how well experimental, computer science, engineering or invention processes and principles were followed. See the scoring guides for a complete description of how your project will be judged. Each project will be given a **gold, silver or bronze rating** based on the marks received on the scoring guide, and the appropriate ribbon will be awarded. In addition, the top projects in each grade level and category will be selected for **Academic Awards**. Students winning Academic Awards will receive a blue rosette on their project and will be asked to attend the Charles N. Kimball Awards Ceremony to receive recognition for their accomplishments.

Students Interview will be for students **ONLY** in grades 7-12. Students are asked to participate in the interview timeframe of the judging night to explain your project. (**Attendance is requested, but not mandatory**.) Students will be released to their project at 7:30pm the night of judging and asked to stand by their project until 8:30pm. During this time, judges will be coming around asking questions and details about your project. The interview process will help all students start preparing for the International Science & Engineering Fair, if their project is one of the top 3.

The **Pioneers in Science Awards** are given to the top five senior level projects. This award is to recognize outstanding examples of student research, innovation and design.

The **Grand Award** is given to the three best ISEF eligible projects in the Senior Level. Students winning the Grand Award will receive an all-expense paid trip to the International Science & Engineering Fair (ISEF).

Over 60 organizations present Special Awards at the Fair. **Special Award Judges** evaluate the projects based upon their organization's interests and priorities. Each organization determines its own awards including plaques, prizes and cash. Students winning Special Awards are asked to attend the Charles N. Kimball Awards Ceremony to receive their award from the sponsoring organization. A list and description of Special Awards organizations may be found on the website at www.sciencecity.com/education

VIII. Student Checklist

BEFORE experimentation, make sure that you…

☐ Read and comply with the Greater Kansas City Science & Engineering Fair rules and protocol as you plan your project.

☐ Make arrangements to work with a mentor (if needed).

☐ **If necessary, complete the following forms with correct signatures and dates BEFORE YOU BEGIN EXPERIMENTING!**

- **Human or Animal Tissue Form (1) -** for projects using human or animal tissue,
- **Human Participants Form (2) -** for all research involving humans (including the human researcher)
- **Hazardous Materials Form (3)-** for projects involve hazardous materials

- **Bacteria Form (4)**- for projects involving bacteria
- **Prior approval to enter as an Individual or Team (non-school sponsored) -** all students from schools that do not have science fairs can enter as a single individual or team. To be allowed to do so students must fill in this form and submit for approval.

Failure to properly complete this step BEFORE EXPERIMENTATION will result in your project being rejected.

AFTER experimentation, make sure that…

☐ You fill out all blanks on your registration and ensure that the abstract or description has been approved by your teacher/ sponsor and upload on STEM Wizard.

☐ You check with your teacher/sponsor to be certain your project is classified correctly.

☐ Your project meets the criteria for an Experimental or Engineering project.

☐ Your project meets all safety and size requirements.

☐ Your paper meets the guidelines for writing a paper or a project description.

☐ You acknowledge those who helped with your project in your paper and with a thank-you note.

☐ **Registration is completed by Deadline date!**

IX. Teacher Checklist

Teachers, make sure…

☐ All certification forms (if necessary) are
   A. Filled out correctly
   B. Signed and dated
   C. Signed by appropriate people (Nurse, parent, etc.)

☐ Mentors are available to work with your students, if necessary.

☐ All blanks on the registration are completed and a complete abstract or description is included.

☐ Each project is classified correctly. (This will ensure proper judging.)

☐ Online registrations are completed, along with the entry fee for each project, by deadline date at 5:00 pm on STEM Wizard.

If you have questions about forms, dates or anything else, call or e-mail Science City:

(816) 460-2261

ssullivan@unionstation.org