

# Engineering Fair Handbook



**Troy R-3**  
**2019-2020**

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# General Information

- If choosing the Engineering Fair Project, the student forfeits the opportunity to enter a “Regional Fair” when a student does an engineering project.
- There are 2 main categories to choose from when doing an engineering project:
  - **Infernal Contraptions:** A Contraption is a deliberately over-engineered or overdone machine that performs a simple task in a very complex fashion, usually in a chain reaction. The category is fashioned after the American cartoonist and inventor *Rube Goldberg*.
  - **Inventions:** The Invention category involves the understanding of how things work together in either a creative or evaluative manner. Invention involves creating something new that focuses on a product that solves a specific problem or need.
- Why/How? Is the Engineering fair different than a traditional model of the Scientific Method in a Science Fair?
  - **Science Fair**
    - Science Fair is to test something to find a pattern
    - Science Fair is a linear process
  - **Engineering Design Process**
    - Engineering fair is building/creating something that solves a problem.
    - An interactive problem solving process
- These six practices are parts of any good engineering project:
  - Asking questions and defining problems
  - Developing and using models
  - Planning and carrying out investigations
  - Analyzing and interpreting data
  - Constructing explanations and designing solutions
  - Obtaining, evaluating, and communicating information

But rather than thinking of them numerically, it is better to think of them interdependently. Each connects to and leads to and from every other one, there is no specific sequence that needs to be followed, and steps can be visited more than once. Note that these concepts can be applied in one form or another to all of the categories in the Engineering Fair.

# Timeline

## Lincoln R-3 Middle School Engineering Fair Project Timeline 2019-2020

Due Dates	Teacher Initials	Date finished	Task /assignment
9/23			Hand out materials for Science Fair or Engineering Fair project.
9/26			Teachers must review the Experimental Design.
10/4			Students should develop and submit their engineering design problem for teacher approval. Student will show the teacher detailed research supporting and aiding their engineering design problem.
10/11			Remind parents of their child's engineering fair project and answer any questions they may have. Students will have completed the brainstorm portion of the engineering design process.
10/25			Students must have a complete blueprint (picture, measurement, material)
11/15			Students must have their first prototype or attempt at their project completed.
1/6			Student must have conducted their engineering design process, analyzed their results, and made improvements.
1/10			Students must have results and conclusion completed from their experiment. Students must have a completed descriptive document.
1/21			Science fair project must be completed and entered in the fair to be judged.
1/21 TMS 2/5			Engineering Board Deadline - by 2:30 pm @ school <b>TSMS</b>
1/23 TMS 2/6			Engineering Fair Judging 7:30 am - 2:30 pm <b>TSMS</b>

## Presentation Display

- Each entry must have a descriptive display for the day of the Engineering Fair event.
- The form of the required display is up to the student. It can be the traditional “tri-fold” type presentation board OR it can be something else that provides the functionality needed.
- The purpose of this display is to show a visitor the goal of the project and the various steps or conclusions that were involved.

## Judging and review of display

The presentation display will be evaluated as one of the aspects of judging for the category. As a minimum the following will be reviewed:

- Display is attractive, easy to read, and the layout is in appropriate logical order.
- If illustrations, photos, charts or graphs are used, they are appropriate and add to the understanding of the project.
- Any visual aids promote the understanding of the entry.
- Please see project display and description for additional requirements.

## Visual Images (Photographs, Charts, Illustrations, Tables, etc.)

Visual images have the following limitations:

- Images must not be offensive or inappropriate (which includes images showing animals of any kind in surgical, necrotizing or dissection situations) determined by the judges.
- Images must have a credit line of origin (“Photograph taken by...” or “Image take from...” or “Graph/Chart/Table taken from...”). If all images were taken or created by the student or are from the same source, one credit line prominently displayed on the presentation is sufficient.
- Images must not provide any public disclosure or identifying information of human subjects, regardless of the method or modality of that public disclosure (i.e., pictures, videos, facial recognition, etc.).
- Any image requiring copyright approval must have an indicating line that such approval has been granted, and the approval letter, or methodology must be available for view by the judging team.

## Space Limitations

- The space for the presentation display is limited to a maximum of 46” wide and 15” deep. Larger spaces are available on request.
- There is no height limit, however the display must be safely self-supporting.
- The display will be placed on a table with other entries, and may hang off of the edge of the table towards the floor. However, it should not extend more than 1” in front of the table, and it should not touch the floor or provide a tripping hazard.
- If needed, the space underneath the table may be utilized to temporarily store additional supplies, replacement items, etc. However, this must be stored neatly and excessive clutter will not be allowed. Entries must fit within the space allowed.

## Larger or Additional space

- A limited number of larger floor spaces will be available. These spaces will be approximately 4' deep by 6' wide in size. The spaces will be against a wall with the other spaces beside them (allowing access on one 6' side).
- The participant is responsible for providing any desired table or structure within that space.
- Any entry in any category may request one of the larger spaces, however, they are limited in number and are available on a first-come, first-serve basis.
- If the number of requests exceeds the number of available spaces, a waiting list will be available in case of cancellations.

## Lab Journal

- Each entry must have a lab journal in addition to the display.
- The lab journal's purpose is to provide viewers with additional insight into the processes, conclusions, details, etc. of the project.
- There is no limit to the length of the lab journal, however providing extensive unrelated information is not recommended.
- If illustrations, photos, charts or graphs are used, they should be appropriate and add to the understanding of the entry.
- If any visual images are used, appropriate credit must be given and any required copyright clearances must be provided.
- Any visual aids should promote the understanding of the project.

## Individual Entries and Team Entries

- Engineering Fair allows entries by both individuals and by teams.
- The team limit size is TWO people per team.
- Team projects and Individual projects will be judged with the same rubrics, and there will not be a different award given for a team vs. an individual.

## Rubrics (Evaluation Forms)

The judging rubric scale allows for a range of 0 to 3 for evaluation in each of the areas - and judges can mark on or between the following general values:

- 0 - Not present
- 1 - Beginning
- 2 - Developing
- 3 - Accomplished

## Judge Entry Review and Discussion/Interview

- Entries that require judge's interview will be notified at least 2 weeks before the competition.
- The judging review/interview time is scheduled for a minimum of 5 minutes and is typically about 10 minutes in duration.
- The interview gives the judges the opportunity to consider the depth of understanding by the entrant and clarify any information that is in question.
- After the interview period is complete, at any time prior to the awards ceremony, judges may re-visit entries.

## General Judging Criteria

In addition to the rubrics details and category descriptions, the judges will use general criteria to help evaluate projects. These are similar to criteria that are in use at other competitions.

### Presentation Display and General Criteria

- **Attractive, easy to read, and layout is in appropriate logical order** - Pictures are neatly colored or printed from a color printer. No glue or tape showing. Spelling and grammar are correct. Items are placed on the board in a logical, orderly manner.
- **Visual aids promote understanding.** - Pictures, models, prototypes are appropriate and are related to the project.
- **Thorough with relative data** - All data presented pertains to the project and serves to clarify project results.
- **Organization and Clarity** – The project should have a well-defined goal or objective. The materials, methods, and design should be sufficient to answer all the appropriate questions. Written and oral communication skills are very important in all STEM fields. Ideas should be clearly presented and easy to understand. Projects should have well-defined goals or purposes which indicate clear understanding. A well-written presentation, easy to follow visual aids, and clear and concise answers all add to the quality of a project.
- **Completeness** – Includes not only the issue of how well the original questions have been addressed, but also the issue of how fully questions arising during the project have been addressed.
- **Artistry** – Project displays provide the same information as those without these aspects, but do so with a certain stylistic element that sets the work apart from others. An elegant project presents the data with an aesthetic that is pleasing to the viewer. Artistry draws the viewers in and keeps them interested in the display.

### Science and Engineering Practices

- **Asks a question/defines a problem**
- **Plan and carry out investigations**

- **Develop and use models**
- **Construct explanations/define solution**
- **Says how they would further design**
- **Analyze and interpret data**
- **Obtain, evaluate, and communicate information**

## Ethics and Original Work

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 any Engineering Fair and/or any subsequent follow-up event.*

- All projects should have an original or innovative aspect to the work at least in either concept or approach. If a pre-existing project is modified or continued from a previous year, the initial work should be credited and the expanded or innovative portions clarified or explained and documented.

## Parental Involvement

- Engineering Fair encourages students to work with their parents. However, the work done on any entry that is to be judged and evaluated for an award MUST be done only by the student(s).
- In the case where a project which has been entered for competition where there is obvious parental involvement, the project will be disqualified.

## Safety Limitations

These safety limitations are intended to provide a positive environment for all attendees, and are minimum requirements. If there are any questions about what is acceptable, or if special considerations are required for a project, please contact your teacher prior to the event to work out a solution.

- No hazardous substances or devices (e.g. poisons, drugs, firearms, weapons, ammunition, and reloading devices) are allowed.
- No flames, explosives, highly flammable materials, or dangerous chemicals are allowed.
- No live animals (of any kind), insects, human/animal parts, or body fluids (for example blood, urine, etc.).
- Any inadequately insulated apparatus producing extreme temperatures that may cause physical burns is not allowed.
- Any apparatus with unshielded belts, pulleys, chains, or moving parts with tension or pinch points must be inactive and for display only.
- Project sounds, lights, odors, or any other display items must not be distracting.



# Engineering Fair Category One: “Invention”

## Category Description

Invention category involves the understanding of how things work together in either a creative or evaluative manner. An invention involves creating something new. Both aspects focus on a product that solves a specific problem or need.

## Project Scope

The projects in this category must describe what problem is being solved. They must also show how the project’s device solves the problem.

## Project Display and Description

A successful project display will include the following:

- Clear explanation of the problem your invention will solve.
- Describe who will use your invention.
- Write a description of the use(s) of the device.
- The benefit(s) associated with your invention.
- Materials and tools needed to build your device are listed.
- Images or illustrations of all parts of your invention.
- Step by step description of how the parts are put together.
- A complete prototype, or construction of the device.

## Entry, Review, and Judging

Judging will include an interview period and potential additional views of the project display. Judges will use an understanding of the category, this document, the rubric, and the general rules in their evaluations. Please review these documents for other items that may be considered.

## What will be Judged

- General rules and judging criteria.
- Overall device clearly described including what it is, how it would be used, and its benefits (on display).
- Preparation and display of the components of the original object (on display).
- The accuracy of explanation of components and overall operation (on display).
- The understanding of the device, how it works, and how it was built (on display & in lab journal).
- Research on similar products or processes (lab journal).
- How well the invention addresses a real-world need, and its practicality in size, cost, materials, etc. (lab journal).

## Rubric

<b>Presentation Display and General Judging</b>	
Attractive, easy to read, and layout is in appropriate logical order	0 - 1 - 2 - 3
Visual aids promote understanding	0 - 1 - 2 - 3
Thorough with relative data	0 - 1 - 2 - 3
Organization and Clarity	0 - 1 - 2 - 3
Completeness	0 - 1 - 2 - 3
Artistry	0 - 1 - 2 - 3
<b>Science and Engineering Practices</b>	
Asks a question/Defines a problem	0 - 1 - 2 - 3
Plan and carry out investigations	0 - 1 - 2 - 3
Develop and use models	0 - 1 - 2 - 3
Construct explanations/Define Solution	0 - 1 - 2 - 3
Says how they would further design	0 - 1 - 2 - 3
Analyze and Interpret data	0 - 1 - 2 - 3
Obtain, evaluate, communicate information	0 - 1 - 2 - 3
<b>Considerations Specific for Invention</b>	
Invention addresses a real-world problem or need	0 - 1 - 2 - 3
Lab Journal includes evidence of multiple attempts and modifications of initial prototype	0 - 1 - 2 - 3
Prototype is relevant and complete enough to show the important aspects of the invention	0 - 1 - 2 - 3
The target audience for the device are identified	0 - 1 - 2 - 3
Components of the device are correctly identified, and functions are accurately described	0 - 1 - 2 - 3
Image of illustrations of components and how they fit together (if present) are explanatory and appropriate	0 - 1 - 2 - 3
The construction sequence is described, complete, accurate and includes tools used.	0 - 1 - 2 - 3
Research on similar products is present in lab journal.	0 - 1 - 2 - 3

# Engineering Fair Category Two: “Infernal Contraptions”

## Category Description

An infernal contraption is a deliberately over-engineered or overdone machine that performs a simple task in a very complex fashion, usually in a chain reaction. The category is fashioned after the American cartoonist and inventor Rube Goldberg (1883-1970). Students in this category are exploring imaginative, non-linear, methods to solve a problem or do a mundane task.

## Project Scope

1. The projects in this category must describe what problem is being solved. They must also show how the project's device solves the problem.
2. Infernal Contraptions use a sequential progression of events, which starts with a simple initialization, from then on, each action triggers one or more following actions.
3. A clearly defined and (usually) simple task is accomplished.
4. Entries in this category will make use of several types of simple machines and physical forces during their sequence of operation. Simple machines include lever, wheel, pulley, inclined plane, screw, and wedge. Physical forces include inertia, gravity, friction, stored energy, etc.
5. Advanced projects will have simultaneous actions in two or more action paths, and/or the same path will be used with different materials or different results more than one time.
6. If the project is strictly a mechanical operation, time is considered. A slow moving part or something that delays operation, while still proceeding, can add complexity.

## Project Display and Description

- The entry should have a diagram (illustration) of the sequence from initial step to conclusion. These illustrations should clearly define the sequence of operation, including direction of force.
- Students should submit a well written sequential procession from beginning to final step.
- Indication of the direction of forces used are clearly identified.
- Prototype of your contraption is present and understandable.
- Simple machines used are present. (Incline plane, pulley, etc.).

Note: If your infernal contraption requires a large space, please let your teacher know as soon as possible.

## Entry, Review, and Judging

Judging will include an interview period and potential additional views of the project display. Judges will use an understanding of the category, this document, the rubric, and the general rules in their evaluations. Please review these documents for other items that may be considered.

## What Will Be Judged

- General rules and judging criteria.
- Sequential progression is clearly labeled with indications of simple machines and physical forces (on display).
- Diagram of operation is complete and understandable (on display).
- The Infernal Contraption is constructed or video recorded, the sequence fully runs with little to no outside intervention (on display).
- Research on similar products or processes (lab journal).

## Rubric

<b>Presentation Display and General Judging</b>	
Attractive, easy to read, and layout is in appropriate logical order	0 - 1 - 2 - 3
Visual aids promote understanding	0 - 1 - 2 - 3
Thorough with relative data	0 - 1 - 2 - 3
Organization and Clarity	0 - 1 - 2 - 3
Completeness	0 - 1 - 2 - 3
Artistry	0 - 1 - 2 - 3
<b>Science and Engineering Practices</b>	
Asks a question/Defines a problem	0 - 1 - 2 - 3
Plan and carry out investigations	0 - 1 - 2 - 3
Develop and use models	0 - 1 - 2 - 3
Construct explanations/Define Solution	0 - 1 - 2 - 3
Says how they would further design	0 - 1 - 2 - 3
Analyze and Interpret data	0 - 1 - 2 - 3
Obtain, evaluate, communicate information	0 - 1 - 2 - 3
<b>Considerations Specific for Infernal Contraption</b>	
Diagram(s) (illustration) is/are complete and shows operation of the contraption from initial step to conclusion	0 - 1 - 2 - 3
Diagram of operation is understandable	0 - 1 - 2 - 3
Sequential steps of progression are clearly labeled	0 - 1 - 2 - 3
Prototype of the whole sequence is presented, it is an important and understandable	0 - 1 - 2 - 3
Numerous types of simple machines are used and identified accurately	0 - 1 - 2 - 3
Several types of physical forces are used and identified correctly, including indication of direction	0 - 1 - 2 - 3
Duration of sequential events (time) is taken into account as part of the sequence	0 - 1 - 2 - 3
Research on similar products is present in lab journal.	0 - 1 - 2 - 3

