

# STEM Projects

## Aerospace

**Identification:** Each exhibit piece must be labeled with the 4-H'er's name, county, and class number. If more than one article is contained in the exhibit each article must be labeled with the 4-H'er's name, county, and class number as well. This may be done with masking tape, attaching an index card, or by writing directly on the back with a marker.

All articles that comprise the exhibit must be attached to each other, *except for the Rocketry Engineering Journal*. The journal must be included with the display, but does not have to be attached to it.

Display Guidelines:

1. Rockets included in a static display must be shown *without* engines or igniters.
2. All parts of the rocket and their function must be identified.
3. Rocket components which must be included and labeled are body tube, nose cone, engine hook, fins, recovery system (parachute), launch lug, engine mount, and shock cord.
4. On the display, list any items required to launch the rocket and their function such as the launch system, igniters and recovery wadding.
5. List the appropriate engine size(s) for your rocket and your level of experience.

**Explanation:** Each exhibit must include a completed [Rocketry Project Description Sheet \(861-25\)](#) attached securely to the project. Exhibitors must answer the description page carefully and in full sentences–this is part of the evaluation. The information in your journal will be used to fill out the [Rocketry Project Description Sheet \(861-25\)](#). Download it early in the process to understand what must be included!

**Evaluation:**

- Rocketry Exhibits are evaluated using the 4-H [Rocketry Evaluation Sheet](#) (861-26).
- Rocketry Exhibits will be judged on neatness of labels, workmanship, and completeness of your Rocketry Engineering Journal. Your journal must include additional elements as you advance through stages, but all journals include:
  - the date of each meeting, names of the persons present and a record of what was done.
  - photos or illustrations of the work in progress
- Educational Displays are evaluated using the *4-H Education Display Evaluation Sheet (214-001)*.

Educational display sizes:

- **Individual exhibits** may be up to 30" wide x 24" deep (front to back) x 36" high
- **Club exhibits** may be up to 60" wide x 24" deep x 36" high.
- **Posters** must not exceed 22"x 28"

*Rocketry displays at the state fair may not include the engines or igniters.  
We appreciate your cooperation in NOT setting our Exhibit Hall on fire!*

## *Aerospace Class Descriptions*

### **Stage 2, Lift-off**

**851 100 010 Rocketry.** An exhibit of two parts: (1) a rocket made by the 4-H'er from the Aerospace

Adventures State 2 project kit, and (2) a Rocketry Engineering Journal.

*Rockets displayed in this class may only be made from the [Estes Gnome](#), Wizard™, or Mosquito™ rocket kits. A Rocketry Engineering Journal is required.*

**851 100 020 Educational Poster–Aerospace.** An educational poster on any aerospace or aeronautics topic youth learned about in Aerospace Adventures, stage 2, except rockets. Display must demonstrate knowledge gained in one of these topics: space, kites, hot air balloons, weather or aerospace careers.

### **Stage 3, Reaching New Heights**

**851 101 010 Rocketry, Stage 3.** An exhibit of two parts: (1) a rocket made by the 4-H'er from the Aerospace Adventures Stage 3 project kits, and (2) a Rocketry Engineering Journal. In Stage 3, the Rocketry Engineering Journal must include a rocket launch and flight report. Rockets displayed in this class may only be made from the Estes Monarch™, Alpha™, or Alpha III™ rocket kits. **A Rocketry Engineering Journal is required.**

**851 101 020 Educational poster- Aerospace, Stage 3.** An educational poster on any aerospace or aeronautics topic youth learned about in Aerospace Adventures, stage 3, except rockets. Display must demonstrate knowledge gained in one of these topics: rocket stabilization methods, airplanes, helicopters, gliders, pilot training, kites, or aerospace careers.

### **Stage 4, Pilot in Command**

**851 102 010 Rocketry, Stage 4.** An exhibit of two parts: (1) a rocket made by the 4-H'er from the Aerospace Adventures Stage 4 project kits, and (2) a Rocketry Engineering Journal. In Stage 4, the Rocketry Engineering Journal must include a rocket launch and flight report. Rockets displayed in this class may be made from the Estes Viking™ rocket kit, or other skill level 1 rocket kit where the 4-H'er designs, constructs, and tests the fin configuration.

**851 102 020 Education poster- Aerospace, Stage 4.** An educational poster on any aerospace or aeronautics topic youth learned about in Aerospace Adventures, stage 4, except rockets. Display must demonstrate knowledge gained in one of these topics: construction and use of altitude tracker, pilot training requirements, aerospace science and technology, astronaut training, box kites, helicopters, or aerospace careers.

## Aerospace Class Numbers

*(Stage 1 is a non-competitive class for Cloverbuds)*

### Stage 2

**851 100 010** Rocketry

**851 100 020** Educational Poster- Aerospace

### Stage 3

**851 101 010** Rocketry

**851 101 020** Educational poster- Aerospace

### Stage 4

**851 102 010** Rocketry

**851 102 020** Education poster- Aerospace

## Computer Science

Exhibit Requirements for All Computer Projects:

Each exhibit piece must be labeled with the 4-H'er's name, county, and class number. If more than one article is contained in the exhibit each article must be labeled with the 4-H'er's name, county, and class number as well. This may be done with masking tape, attaching an index card, or by writing directly on the back with a marker. All articles that comprise the exhibit must be attached to each other. Each exhibit must include a completed Project Description Sheet attached securely to the project. 4-H Project Description sheets are posted on the state website and updated semi-annually, so be sure to check for the latest version. Exhibitors must answer the description page **carefully** and **in full sentences**—this is part of the evaluation. Judging Evaluations can be found on the state 4-H website. These provide valuable information to youth on creating their project displays.

### ***4-H Computer Project Description Sheets @ Evaluation Guides:***

[Computer Hardware Project Description](#) (861-09)

[Computer Hardware Project Evaluation Sheet](#) (861-10)

[Computer Programming Project Description](#) (861-11)

[Computer Programming Project Evaluation Sheet](#) (861-01)

[Computer Software Application Project Description](#) (861-13)

[Computer Software Application Evaluation Sheet](#) (861-14)

In some cases, the exhibit may be a poster or a three-dimensional display. Individual exhibits are **limited in size to 30" wide, 24" deep (front to back), and 36" high. Club exhibits are limited in size to 60" wide, 24" deep and 36" high.** Posters must not exceed 22"x 28". *These*

*classes are open to all 4-H'ers without being enrolled in the 4-H computer project. See additional exhibit requirements for Technology classes.*

A print version of the program must be submitted unless otherwise noted in the class description below. Youth are responsible for submitting clear directions on how judges can access the files, read code, and start programs. You may include a disk, CD or thumb/travel drive as part of your exhibit. All files must be compatible with use on a PC. Submit only one exhibit per disk, CD or thumb/travel drive.

Value is placed on projects that model the learning process or show how the participant's skills have increased while completing the project.

**The youth exhibitor must identify a problem to solve or create a work application involving technology. Possible ideas might include: applying existing software programs to a 4-H project area, composing music, developing a game, drawing landscape scenes, designing buildings, publishing club newsletters, creating a website, editing a video, working with photographs, etc.**

Online projects using Google applications or other Web 2.0 software are acceptable. Youth must make sure clear directions are given in the project explanation so the judges can find and access the project online. Website exhibits must be viewable online or on a disk, CD or thumb/travel drive.

Exhibits entered in the "Programming" class must be a program written, translated, or substantially (at least 30%) altered by the 4-H member. In the programming projects please submit a hard copy or thumb/travel drive for programs with excessive pages such as *GameMaker* software and working files so the judge can see the code. Submit a URL that points to the development software so it can be downloaded. If youth are submitting more than one exhibit or class using a disk, CD or thumb/travel drive each exhibit must be on a separate drive in a self-closing bag with the associated exhibit tag.

## Computer Science Classes

For the Class numbers below, fill in blank ( \_ ) with one of the following numbers:

- 11 - **Junior**, *First year in this project area*
- 21 - **Other Junior**
- 12 - **Intermediate**, *First year in this project area*
- 22 - **Other Intermediate**
- 13 - **Senior**, *First year in this project area*
- 23 - **Other Senior**
- 34 - **Club Exhibit**

861 100 1\_\_ Computer Software Application, Word Processing

861 101 1\_\_ Computer Software Application, Excel/Spreadsheet

861 102 1\_\_ Computer Software Application, Presentation Software

861 103 1\_\_ Computer Software Application, Graphic Design/Digital Imaging

861 104 1\_\_ Computer Software Application, Database Management

861 105 1\_\_ Computer Software Application, Multimedia Projects

861 100 2\_\_ Computer Programming  
861 100 3\_\_ Computer Hardware Design  
861 100 4\_\_ Computer 3D Printer Application

*All classes must also follow the exhibit requirements above for Computer classes. Evaluations use Computer Software Application Evaluation Sheet [\(861-14\)](#).*

## Descriptions

**861 100 1\_\_ Computer Software Application, Word Processing.** Projects created by youth that show learning around word processing. Project must be an original creation by the participant that shows their word processing skills.

**861 101 1\_\_ Computer Software Application, Excel/Spreadsheet.** Projects created by youth that show learning in the area of spreadsheet design and usage. The exhibit must be a spreadsheet or chart within an Excel document, not a chart imported in to a word processing program. Project must be an original creation by the participant that shows their spreadsheet skills. Intermediate and Senior members are expected to have some formula usage in their project.

**861 102 1\_\_ Computer Software Application, Presentation Software.** Projects must be created by youth to show learning in the area of presentation design skills. Software can be any current presentation software including online versions like Google applications or voicethread.com. Project must be created by the participant to show their presentation design skills. Youth can also submit video clips of how the presentation was used. (For example: A video clip of the youth using the presentation in a group activity.)

**861 103 1\_\_ Computer Software Application, Graphic Design/Digital Imaging.** Projects created by youth that show learning in the area of graphic design or digital imaging. Software can be any current presentation software including online versions. Project must be created by the participant to show their graphic design or digital imaging skills.

**861 104 1\_\_ Computer Software Application, Database Management,** Projects created by youth that show learning in the area of database management. Project must be an original creation by the participant that shows their spreadsheet skills. Intermediate and Senior members are expected to have apply their projects to real world scenarios. Youth are responsible for submitting clear directions on how judges can access the files.

**861 105 1\_\_ Computer Software Application, Multimedia Projects,** Projects created by youth that show learning in the area of Multimedia Projects. Software can be any current software including online versions. Typically, exhibitors using online software or platforms provide a QR Code or link for judges to access. Project must be created by the participant to show their multimedia skills. In general, multimedia includes a combination of text, audio, still images, video, or animation. Multimedia combines multiple content forms. Youth are responsible for submitting clear directions on how judges can access the files.

**861 100 2\_\_ Computer Programming** Projects created by youth that show learning in the area of programming. Project must be created by the participant to show their programming skills. Hard copy or travel/thumb drive (for programs with excessive pages, such as

GameMaker software) of the program must be submitted. It is up to the youth to ensure the program will function or display at Fair.

Youth are responsible for submitting clear directions on how judges can access the files. Submit information that allows a judge to look at the programming code in order to evaluate your work on the *Computer Programming Project Description Form*.

*If only an executable (compiled) product is submitted, the project cannot be judged in the computer programming class.*

**861 100 3\_\_ Computer Hardware** Design Projects created by youth that show learning in the area of hardware. Project must be an original creation by the participant that shows their computer hardware skills. It is up to the 4-H'er to ensure the hardware and project will function or display at Fair. Intermediate and Senior members are expected to have applied their projects to real world scenarios. Youth are responsible for submitting clear directions on how judges can access the files.

**861 100 4\_\_ Computer 3D Printer Application**

Projects created by youth that show learning in the area of 3D design and printing on a 3D printer. Project must be an original creation by the participant that shows their skills. Each exhibit must include the item created with the 3D printer and a series of screen shots from the design software that show the (1) early stages, (2) middle stages and (3) final stages of the design process. Application Project Description for the exhibit form filled out neatly and securely attached to the exhibit. *4-H Project Description* sheets are posted on the state website.

## Electrical Engineering (Electricity)

There are three types of Electricity exhibits available at the State Fair: *Electricity, levels 1–4; Electricity Education Poster, levels 1–4, and Other Electricity Exhibits* (Jr, Int, Sr, and Club). Electricity exhibits must be labeled with the 4-H'er's name, county, and class number. If more than one article is contained in the exhibit, each article must be labeled with the 4-H'er's name, county, and class number and number of items (1 of 2, 2 of 2, etc). This may be done with masking tape, by attaching an index card, or by writing directly on the back with a marker. All the articles that comprise the exhibit must be attached to each other or contained in a zip closure bag. To qualify for judging, an *Electric Energy Explanation Card* ([862-02](#)) must be attached to the exhibit. Forms are available at the county Extension offices and on the [State 4-H website](#).

**In addition, Intermediates and Seniors must include a schematic or circuit diagram of the electricity project.** Refer to the 4-H Electric Series Level 2 book [Investigating Electricity](#) and the interactive e-learning modules for Activities 5 and 6 and Activities 7-9. The Level 4 book [Entering Electronics](#) will also be a useful reference for this requirement.

The exhibit may be a poster or a three-dimensional display.

Size limits are:

- Individual exhibits should be max 30" wide x 24" deep (front to back) x 36" tall
- Club exhibits can be up to a max of 60" wide x 24" deep x 36" tall

For the class numbers below, fill in blank in class number ( \_ \_ ) with one of the following numbers:

11 - **Junior**, *First year in this project area*

21 - **Other Junior**

12 - **Intermediate**, *First year in this project area*

22 - **Other Intermediate**

13 - **Senior**, *First year in this project area*

23 - **Other Senior**

34 - **Club Exhibit**

**862 100 1 \_ \_ Electricity, Level 1**

**862 100 2 \_ \_ Electricity, Level 2**

**862 100 3 \_ \_ Electricity, Level 3**

**862 100 4 \_ \_ Electricity, Level 4**

**862 101 1 \_ \_ Education Poster - Electricity, Level 1**

**862 101 2 \_ \_ Education Poster - Electricity, Level 2**

**862 101 3 \_ \_ Education Poster - Electricity, Level 3**

**862 101 4 \_ \_ Education Poster - Electricity, Level 4**

## Class Explanations

**862 100 1 \_ \_ Electricity, Level 1** An exhibit on any electricity topic youth learned about in [Electric Excitement Level 1: Magic of Electricity](#) addressing any of these themes: workings of an incandescent light bulb, workings of a switch, conductors, insulators, open/closed circuits, series or parallel circuit design, magnetism, workings of a compass, use of a galvanometer, workings of a motor.

**862 100 2 \_ \_ Electricity, Level 2** An exhibit on any electricity topic youth learned about in [Electric Excitement Level 2: Investigating Electricity](#) addressing any of these themes: direct and alternating current, workings of a Volt-Ohm meter, Ohm's Law, conductors, insulators, wiring diagrams, measuring voltage, circuits, momentary switches, three-way switches, soldering, "build a burglar alarm."

**862 100 3 \_ \_ Electricity, Level 3** An exhibit on any electricity topic youth learned about in [Electric Excitement Level 3: Wired for Power](#) addressing any of these themes: electrical tools, electrical meter, identify wire and cable symbols, light bulbs, appliance nameplate information, electricity usage, receptacles, circuits, grounded and non-grounded outlets, an explanation of wall switch replacement.

**862 100 4 \_ \_ Electricity, Level 4** An exhibit on any electricity topic youth learned about in [Electric Excitement Level 4: Entering Electronics](#) addressing any of these themes: identification of electronic parts, soldering and preparing a circuit assembly, demonstrate how a diode controls current flow, develop a circuit that shows the action of a transistor to regulate current flow, understand polarity and voltage limits of LEDs, use of a light sensitive

semiconductor, assemble a circuit that gives a meter reading in response to light, show how a Silicon Controlled Rectifier (SCR) triggers an alarm, use an integrated circuit in an amplifier circuit.

### *Explanation and Evaluation of Posters*

The exhibit may be a poster or a three-panel two-fold display board. Posters may not exceed 22"x26". Individual exhibits are limited in size to 30" wide, 24" deep (front to back), and 36" high. Club exhibits are limited in size to 60" wide, 24" deep and 36" high. An [Educational Display Explanation Card \(000-01\)](#) must be attached. Judging criteria are outlined on [4-H Educational Display Evaluation Sheet \(214-001\)](#).

**862 101 1 \_\_ Education Poster - Electricity, Level 1** An educational poster on any electricity topic youth learned about in [Electric Excitement Level 1: Magic of Electricity](#) addressing any of these themes: workings of an incandescent light bulb, workings of a switch, conductors, insulators, open/closed circuits, series or parallel circuit design, magnetism, workings of a compass, use of a galvanometer, workings of a motor.

**862 101 2 \_\_ Education Poster - Electricity, Level 2** An educational poster on any electricity topic youth learned about in [Electric Excitement Level 2: Investigating Electricity](#) addressing any of these themes: direct and alternating current, workings of a Volt-Ohm meter, Ohm's Law, conductors, insulators, wiring diagrams, measuring voltage, circuits, momentary switches, three-way switches, soldering, "build a burglar alarm."

**862 101 3 \_\_ Education Poster - Electricity, Level 3** An educational poster on any electricity topic youth learned about in [Electric Excitement Level 3: Wired for Power](#) addressing any of these themes: electrical tools, electrical meter, identify wire and cable symbols, light bulbs, appliance nameplate information, electricity usage, receptacles, circuits, grounded and non-grounded outlets, an explanation of wall switch replacement.

**862 101 4 \_\_ Education Poster - Electricity, Level 4** An educational poster on any electricity topic youth learned about in [Electric Excitement Level 4: Entering Electronics](#) addressing any of these themes: identification of electronic parts, soldering and preparing a circuit assembly, demonstrate how a diode controls current flow, develop a circuit that shows the action of a transistor to regulate current flow, understand polarity and voltage limits of LEDs, use of a light sensitive semiconductor, assemble a circuit that gives a meter reading in response to light, show how a Silicon Controlled Rectifier (SCR) triggers an alarm, use an integrated circuit in an amplifier circuit.

## Other Electricity Exhibits

Each exhibit piece must be labeled with the 4-H'er's name, county, and class number. Fill in the blank in class number (\_\_) with corresponding number for Junior, Intermediate, or Senior 4-H'er.

### **862 200 00\_\_ Other Electricity Exhibit**

1. Junior
2. Intermediate
3. Senior



#### 4. Club

**Exhibit:** An exhibit relating to electricity addressing a different theme or using a different combination of components from those addressed in 4-H Electricity Levels 1-4. The exhibit may NOT be a poster or a robot (see the exhibit classes for Junk Drawer Robotics). It may be made from a kit, from a pattern or plan not included in 4-H Electricity Levels 1-4, or an item designed by the 4-H'er.

To qualify for judging an *Electric Energy Explanation Sheet (862-02 Revised 9/2016)* must be attached to the exhibit. Forms are available at the county Extension offices and at the State 4-H website.

**In addition, intermediates and seniors must include a schematic or circuit diagram of the electricity project.**

Refer to [Electric Excitement Level 2: Investigating Electricity](#) and the interactive e-learning modules for

Activities 5 and 6 and Activities 7-9. [Electric Excitement Level 4: Entering Electronics](#) will also be a useful reference for this requirement.

## Engineering Design

**Eligibility:** Open to all 4-H members regardless of project enrollment. The purpose of this type of exhibit is for members to communicate the processes and outcomes of solving an engineering problem. The display must include two parts: (1) An engineering notebook that details the seven Engineering Design Components and (2) an educational poster for display.

**Explanation and Evaluation:** An [Educational Display Exhibit Card \(000-01\)](#) must be attached to the poster. Judging criteria are outlined on the [4-H Engineering Display Evaluation Sheet](#).

*The notebook* must include, in detail, all seven engineering design components below. The engineering notebook will be judged on:

6. Readability
7. Inclusion of all seven of the required engineering design components
8. The [Engineering Display Component Check-off Sheet](#) which must be included as the first page of the notebook.
9. Intermediates and Seniors must also include a bibliography or list of citations for their research in the journal.

The poster must communicate the 4-H'er's work on engineering design components #(4) through #(7).

The poster text must be illustrated with drawings and/or photos. The poster will be judged on:

1. the inclusion of Engineering Design Components 4-7
2. readability, design, and workmanship

Review the [Engineering Display Evaluation Sheet](#) for a complete list of judging criteria.

**Identification:**

- All parts of the display must be attached to one another to keep the exhibit together as a unit.
- Each piece of an exhibit must have the 4-H'er's name, county, and class number securely attached to it.
- Label the engineering notebook with exhibitor's name, county, and class number.
- Club projects must be entered under the club name and must include the names of all members and leaders. This may be on a separate paper, securely attached to the back of the exhibit. A club exhibit will receive one ribbon per exhibit.

**Display:** Single posters may be displayed by hanging or stapling to the wall. All other displays must be free-standing.

- Maximum poster size is 30" x 24"
- All parts of the display must be able to last the duration of the fair in good repair.

**Safety & Sustainability:** Exhibits that include pictures, models, diagrams, and other materials must meet the safety standards listed below. Drawings or photos which are an essential part of the display must be firmly attached to the board. Drawings or photos are required for the build, test, and redesign report sections of the display. Loose materials like soil, bark or sand must be displayed in closed containers.

**The following materials will not be allowed on the display for safety reasons:**

- Living organisms-plants or animals
- Any liquids
- Aerosol bottles or other pressurized gases
- Glass
- Hazardous substances
- Sharp items

## Engineering Design Class Numbers

**841 100 001** Junior Engineering Design Display

**841 100 002** Intermediate Engineering Design Display

**841 100 003** Senior Engineering Design Display

**841 100 004** Club Engineering Design Display

## *Engineering Design Components*

1. **A problem statement** or need and justification. What is the problem or need? Why is it important to solve?
2. **Background research.** Who are the users or customers? Are there existing solutions to similar problems? What design mistakes have been made in the past? Intermediates and Senior members must include a bibliography or list of citations for their research.
3. A list of your **proposed solutions** to the design problem based on your research. A minimum of two proposed solutions is required. Explain why you chose a design to test.
4. A plan or **design brief.** Plan and outline the process of building your prototype. The design brief defines materials needed, a sketch of the prototype, and a description of how the prototype will function.

5. **A build report.** List your building steps. List any new problems you encounter. Include drawings or photographs of your process.
6. **A test and redesign report.** List your testing and redesign steps. The engineering design process may involve many test versions to get to a final prototype. Include drawings or photographs of your process.
7. An explanation of how your final prototype **solves the original problem** or need. If you were unable to solve the problem or need explain what else you think needs to be done to reach a solution?

# Industrial Arts

You may enter ATV, automotive, bicycles, handyman, small engines, snowmobile, etc., projects in the Educational Display classes found in the Communications section of the fair book.

## Welding

Projects in this class are designed for practical use, artistic purpose, or demonstration of skills. The techniques used can include Shielded Metal Arc Welding/Stick, Gas Metal Arc Welding/MIG, Gas Tungsten Arc Gas Welding/TIG, Flux-cored Arc Welding, Oxy-fuel Welding, or other metal joining techniques that require the heating of surfaces to the point of melting.

**Evaluation:** A completed [Welding Explanation Card \(861-01\)](#) is required to qualify the exhibit for judging. Judging criteria are outlined on [Welding Criteria \(861-03\)](#) and the evaluation can be found on [4-H Welding Evaluation Sheet \(861-02\)](#)

**861 100 001** Welding, Junior

**861 100 002** Welding, Intermediate

**861 100 003** Welding, Senior

# Wood Science

Wood Science exhibits must be made primarily of wood by the 4-H'er. Musical instruments and furniture of any kind must be entered in the *Specialty Classes*.

**Explanation & Judging:** A completed [Wood Science Explanation Sheet \(871-02\)](#) is required to qualify the exhibit for judging. Judging criteria are outlined on [Wood Science Evaluation Sheet \(871-01\)](#).

**Identification:** Each exhibit should be labeled with the 4-H'ers name, county, and class number.

## General Wood Science Exhibits

**871 100 001** Wood Science–Junior, *First Year*

**871 100 011** Wood Science–Other Junior

**871 100 002** Wood Science–Intermediate, *First Year*

**871 100 012** Wood Science–Other Intermediate

**871 100 003** Wood Science–Senior, *First Year*

**871 100 013** Wood Science–Other Senior

**871 100 034** Wood Science–Club

## **Specialty Wood Science Exhibits**

These classes are for exhibiting musical instruments and furniture of any kind primarily made of wood by the 4-H participant. The same Explanation Cards and Evaluation Sheets will be used as above.

**871 200 001** Wood Science Musical Instrument, Junior

**871 200 002** Wood Science Musical Instrument, Intermediate

**871 200 003** Wood Science Musical Instrument, Senior

**871 300 001** Wood Science Furniture, Junior

**871 300 002** Wood Science Furniture, Intermediate

**871 300 003** Wood Science Furniture, Senior