

DIVISION D - MECHANICAL SCIENCES

D-1 Computers

1. 4-H members may stay in a Unit for more than one year. The exhibit must be different each year.
2. Youth are only allowed to enter a display board exhibit or programming or a stand-alone exhibit, not all.

Beginning programming – simple program using Scratch (or other simple graphic programming language). The program should include 8 different commands including looping and getting input from the keyboard and mouse.

Intermediate programming – a program using Scratch (or other simple graphic programming language) that you have downloaded from the internet and modified. Compare the two programs and demonstrate the changes you have made to the original program; OR create an animated storybook or video game using Scratch (or other simple programming language).

Advanced programming – an original program using a higher-level programming language such as Python, Javascript, C++, etc. Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

Discovering Computer Science & Programming Through Scratch – Level 1

Class

Display Board Exhibits

1. Computer Science – Junior
2. Computer Science – Intermediate
3. Computer Science – Senior

Beginning Programming

4. Beginning Programming - Junior
5. Beginning Programming – Intermediate
6. Beginning Programming – Senior

Stand-Alone Exhibits

7. Computer Science - Junior
8. Computer Science – Intermediate
9. Computer Science – Senior

Discovering Computer Science & Programming Through Scratch – Level 2

Class

Display Board Exhibits

10. Computer Science – Intermediate
11. Computer Science – Senior

Intermediate Programming

12. Intermediate Programming – Intermediate
13. Intermediate Programming – Senior

Stand-Alone Exhibits

14. Computer Science – Intermediate
15. Computer Science – Senior

Discovering Computer Science & Programming Through Scratch – Level 3

Class

Display Board Exhibits

16. Computer Science – Intermediate
17. Computer Science – Senior

Advanced Programming

18. Advanced Programming – Intermediate
19. Advanced Programming – Senior

Stand-Alone Exhibits

20. Computer Science – Intermediate
21. Computer Science – Senior

Computers in the 21st Century

Display Board Exhibits

22. Computers 21st Century – Intermediate
23. Computers 21st Century – Senior

Stand-Alone Exhibits

24. Computers 21st Century – Intermediate
25. Computers 21st Century – Senior

Exhibits will consist of the following:

A. One sturdy binder/notebook that contains the Discovering Computer Science & Programming Through Scratch manuals for that unit and completed e-Record.

B. A completed exhibit consists of *ONE* of the following:

1. A display board illustrating a topic learned as a part of the 4-H project. The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board. All items

must be attached to display board.

2. **Programming Exhibit** (a printed copy of a digital presentation is required and placed in your e-record.)

Electronic equipment will only be used during judging time and will not remain on display during the fair. Programs available online (such as Scratch) should include a link to the specific project you have created.

Beginning Programming – a simple program using Scratch (or other simple graphic programming language). The program should include 8 different commands including looping and getting input from the keyboard and mouse.

Intermediate Programming – a program using Scratch (or other simple graphic programming) that you have downloaded from the internet and modified. Compare the two programs and demonstrate the changes you made to the original program; OR create an animated storybook or video game using Scratch (or other simple graphic programming language).

Advanced Programming – an original program using higher level programming language such as Python, Javascript, C++, etc.

3. A stand-alone exhibit demonstrating a skill learned or an item developed. For example, a Makey Makey keyboard or a microcontroller project. All stand-alone projects are subject to risks of display at county and state fair if eligible.

D-2 Electricity

Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

NOTE: Please make sure that all items are attached securely to the exhibit and that they are labeled with the name of the exhibitor. Judges will judge entire electricity project for a cash award given by K.C. Electric Assn. - 1st-\$100, 2nd-\$75 and 3rd-\$50.

Class

1. Unit 1 - Magic of Electricity - Junior

2. Unit 1 - Magic of Electricity - Intermediate

3. Unit 1 - Magic of Electricity - Senior

Exhibit will consist of the following:

A. Completed 4-H Electric project manual (at least three required activities completed; at least four Optional activities – Brain Boosters completed; at least two leadership activities completed); and e-Record presented in a sturdy binder/notebook.

B. One article or display board (not both) which you have made as a part of this unit of study. (Example: homemade flashlight, simple switch, circuit with two batteries and one light bulb, compass, electromagnet, galvanometer, electric motor, etc.). The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each separate part with your name and county.

4. Unit 2 - Investigating Electricity - Junior

5. Unit 2 - Investigating Electricity - Intermediate

6. Unit 2 - Investigating Electricity - Senior

Exhibit will consist of the following:

A. Completed 4-H Electric project manual (at least three required activities completed; at least four Optional activities – Brain Boosters completed; at least two leadership activities completed); and e-Record presented in a sturdy binder/notebook.

B. One article or display board (not both) which you have made as a part of this unit of study. (Example: circuit diagrams with explanation, series circuit, parallel circuit, momentary switch, three-way switch, soldered connection, rocket launcher, burglar alarm, etc.). The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each separate part with your name and county.

7. Unit 3 - Wired For Power - Junior

8. Unit 3 - Wired For Power - Intermediate

9. Unit 3 - Wired For Power - Senior

Exhibit will consist of the following:

A. Completed 4-H Electric project manual (at least three required activities completed; at least four Optional activities – Brain Boosters completed; at least two leadership activities completed); and e-Record presented in a sturdy binder/notebook.

B. One article or display board (not both) which you have made as a part of this unit of study. (Example: electrical tool and supply kit, display of symbols on wires and cables and their meanings, display of light bulbs and the jobs they do best, display board on how to read an appliance name tag, chart showing the electrical usage of appliances, display board on how to replace a switch, etc.) The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each separate part with your name and county.

10. Unit 4 - Entering Electronics - Senior Advanced

Exhibit will consist of the following:

A. Completed 4-H Electric project manual (at least three required activities completed; at least four Optional activities – Brain Boosters completed; at least two leadership activities completed); and e-Record presented in a sturdy binder/notebook.

B. One article or display board (not both) which you made as a part of this unit of study. (Example: display of electronic parts, diode, transistor, light-emitting diode (LED), LED flasher photocell alarm, light meter, silicon controlled rectifier

(SCR) intruder alarm, 6-8 watt amplifier with integrated circuit, etc.) The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each separate part with your name and county.

D-3 Small Engines

Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

Class

1. Unit 1 - Crank It Up - Junior
2. Unit 1 - Crank It Up - Intermediate
3. Unit 1 - Crank It Up - Senior

Exhibits will consist of the following:

A. A completed Small Engines manual (page 4 – at least 7 activities completed) and e-Record presented in a sturdy binder/notebook including appropriate sections in the manual completed and other items such as diagrams, drawings, photographs or attachments related to activities in the manual.

B. Exhibit may be a display board or a stand-alone item (but not both) such as: air and fuel systems, the electrical systems, a diagram of the engine block, etc. A display board can be on any topic from the Small Engines manual. You may use diagrams, drawings and photographs. Label and use captions to make your display as educational as possible. The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each item with name and county.

4. Unit 2 - Warm It Up - Junior
5. Unit 2 - Warm It Up - Intermediate
6. Unit 2 - Warm It Up - Senior

Exhibits will consist of the following:

A. A completed Small Engines manual (page 4 – at least 7 activities completed) and e-Record presented in a sturdy binder/notebook including appropriate sections in the manual completed and other items such as diagrams, drawings, photographs or attachments related to activities in the manual.

B. Exhibit may be a display board or a stand-alone item (but not both) such as: air and fuel systems, the electrical systems, a diagram of the engine block, etc. A display board can be on any topic from the Small Engines manual. You may use diagrams, drawings and photographs. Label and use captions to make your display as educational as possible. The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each item with name and county.

7. Unit 3 - Tune It Up - Junior
8. Unit 3 - Tune It Up - Intermediate
9. Unit 3 - Tune It Up - Senior

Exhibits will consist of the following:

A. A completed Small Engines manual (page 4 – at least 7 activities completed) and e-Record in a sturdy binder/notebook including appropriate sections in the manual completed and other items such as diagrams, drawings, photographs or attachments related to activities in the manual.

B. Exhibit may be a display board or a stand-alone item (but not both) such as: air and fuel systems, the electrical systems, a diagram of the engine block, etc. A display board can be on any topic from the Small Engines manual. You may use pictures or any records you kept to provide evidence of your accomplishments and what you learned. Label and use captions to make your display as educational as possible. The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

C. Label each item with name and county.

10. Unit 4 - Advanced Small Engines - Junior
11. Unit 4 - Advanced Small Engines - Intermediate
12. Unit 4 - Advanced Small Engines – Senior

NOTE: This unit can be used for any type of engine (tractor, car etc.)

Exhibits will consist of the following:

A. A completed Small Engine Unit 4 e-Record with emphasis on your accomplishments in your story presented in a sturdy binder/notebook. (Self-Determined)

B. Include the following information in the Small Engine Unit 4 e-Record:

1. Written description of your project:

- a. goals
- b. plans
- c. accomplishments
- d. evaluation

C. Exhibit may be a display board or a stand-alone item (but not both) such as: air and fuel systems, the electrical systems, a diagram of the engine block, etc. A display board can be on any topic related to Engines. You may use diagrams, drawings, charts and photographs. Label and use captions to make your display as educational as possible. The standardized display board size of 4' X 3' is to be used for 4-H projects. No additional items may be included in front of display board.

D. Label each item with name and county.

D-4 Model Rocketry

NOTE: For All Units:

1. Rocket exhibits must relate to the skill level for the unit entered. Units 1-4 should include the color picture of the rocket and skill level title from the rocket kit package as part of their record book. All project material must be organized and secured in a sturdy binder/notebook. Unit 6 must have a copy of plans or blueprints including instructions "step by step" to build the rocket.
2. Fins must be balsa wood (balsa and basswood) and finished with paint in classes indicated. **No plastic fins for Units 1-3.**
3. Fins of plastic or other materials must be exhibited in Units 4 and 6.
4. Unit 4 members may build Skill Level 4 and Skill Level 5 rocket kits.
5. Rockets are to be displayed and held **vertically** by a substantial rod or support no taller than the rocket on a stationary base appropriate to the size of the rocket, not to exceed 12" x 12" x 1" thick. Only the rocket will be judged. Do not decorate the base. No triangular stands can be used for displaying the rocket.
6. Do not include live or expended engines in the rocket exhibited.
7. If rocket is damaged in launching, it can still be judged for quality of construction, e-Record and pictures.
8. Display rockets cannot be used for the Rocket Fly Day competition at State Fair.
9. No launching pads should be used for displaying the rockets.
10. All rockets must be exhibited upright.
11. Launching your rocket is not a requirement. It is a good idea, however, to make 2 rockets – one for exhibit and one to launch if possible.
12. Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

Class

Balsa Fins Only

1. Unit 1 - Introduction to Rocketry - Junior
2. Unit 1 - Introduction to Rocketry - Intermediate
3. Unit 1 - Introduction to Rocketry - Senior

Exhibit will consist of the following:

- A. Completed Model Rocketry e-Record presented in a sturdy binder/notebook.
- B. On the Model Rocketry page enter the rockets you built in this unit. Include the following information:
 1. Model name; skill level; from a stock kit, modified kit or self-designed-and-built.
 2. Power: single-stage, multi-stage: cluster.
 3. Fuselage: single-tube or glider rear-engine or glider front-engine or glider-canard.
 4. Engine information: engine code, label color, and type of recovery system.
- C. If the rocket was launched provide the following information on the Model Rocket page:
 1. Number of times successfully launched; kind of launch pad used.
 2. Kind of electrical system used
 3. Tracking method used
 4. Observer's distance from rocket; angle achieved and altitude achieved; any special problems before, during and after launching
 5. What did you do to overcome the problems you encountered?
- D. One rocket personally built or display related to work done at Skill Level I.
- E. Label each item with name and county.

Balsa Fins Only

4. Unit 2 - Basic Model Rocketry - Junior
5. Unit 2 - Basic Model Rocketry - Intermediate
6. Unit 2 - Basic Model Rocketry - Senior

Exhibit will consist of the following:

- A. Completed Model Rocketry e-Record presented in a sturdy binder/notebook.
- B. On the Model Rocketry page enter the rockets you built in this unit. Include the following information:
 1. Model name; skill level; from a stock kit, modified kit or self-designed-and-built.
 2. Power: single-stage, multi-stage: cluster.
 3. Fuselage: single-tube or glider rear-engine or glider front-engine or glider-canard.
 4. Engine information: engine code, label color, and type of recovery system.
- C. If the rocket was launched provide the following information on the Model Rocket page:

1. Number of times successfully launched; kind of launch pad used.
 2. Kind of electrical system used
 3. Tracking method used
 4. Observer's distance from rocket; angle achieved and altitude achieved; any special problems before, during and after launching
 5. What did you do to overcome the problems you encountered?
- D. One rocket personally built or display related to work done at Skill Level II.
- E. Label each item with name and county.

Balsa Fins Only

7. Unit 3 - Intermediate Model Rocketry - Junior
8. Unit 3 - Intermediate Model Rocketry - Intermediate
9. Unit 3 - Intermediate Model Rocketry - Senior

Exhibit will consist of the following:

- A. Completed Model Rocketry e-Record with completed questions in manual pages 31-35 presented in a sturdy binder/notebook.
- B. On the Model Rocketry page enter the rockets you built in this unit. Include the following information:
 1. Model name; skill level; from a stock kit, modified kit or self-designed-and-built.
 2. Power: single-stage, multi-stage: cluster.
 3. Fuselage: single-tube or glider rear-engine or glider front-engine or glider-canard.
 4. Engine information: engine code, label color, and type of recovery system.
- C. If the rocket was launched provide the following information on the Model Rocket page:
 1. Number of times successfully launched; kind of launch pad used.
 2. Kind of electrical system used
 3. Tracking method used
 4. Observer's distance from rocket; angle achieved and altitude achieved; any special problems before, during and after launching
 5. What did you do to overcome the problems you encountered?
- D. One rocket personally built in unit or display related to work done at Skill Level III.
- E. Label each item with name and county.

Finished fins of any type

10. Unit 4 - Advanced Model Rocketry - Junior
11. Unit 4 - Advanced Model Rocketry - Intermediate
12. Unit 4 - Advanced Model Rocketry - Senior

Exhibit will consist of the following:

- A. Completed Model Rocketry e-Record with completed questions in manual pages 14-18 presented in a sturdy binder/notebook.
- B. On the Model Rocketry page enter the rockets you built in this unit. Include the following information:
 1. Model name; skill level; from a stock kit, modified kit or self-designed-and-built.
 2. Power: single-stage, multi-stage: cluster.
 3. Fuselage: single-tube or glider rear-engine or glider front-engine or glider-canard.
 4. Engine information: engine code, label color, and type of recovery system.
- C. If the rocket was launched provide the following information on the Model Rocket page:
 1. Number of times successfully launched; kind of launch pad used.
 2. Kind of electrical system used
 3. Tracking method used
 4. Observer's distance from rocket; angle achieved and altitude achieved; any special problems before, during and after launching
 5. What did you do to overcome the problems you encountered?
- D. One rocket personally built in unit or display related to work done at Skill Level IV.
- E. Label each item with name and county.

Finished fins of any type

13. Unit 6 - Designer Model Rocketry - Junior
14. Unit 6 - Designer Model Rocketry - Intermediate
15. Unit 6 - Designer Model Rocketry - Senior

Exhibit will consist of the following:

- A. Completed Model Rocketry e-Record with design worksheets and completed questions in manual on pages 35-39, presented in a sturdy binder/notebook. Include a copy of the plans or blueprints on how to build the rocket.
- B. If a rocket was launched provide the following information on the Model Rocketry page:

1. Number of times successfully launched; kind of launch pad used.
 2. Kind of electrical system used
 3. Tracking method used
 4. Observer's distance from rocket; angle achieved and altitude achieved; any special problems before, during and after launching
 5. What did you do to overcome the problems you encountered?
- C. One rocket personally designed, built (no kits) and used in unit or display related to work done.
- D. Label each item with name and county.

D-5 Robotics & Engineering

1. In Junk Drawer Units (1-3), youth are only allowed to enter a display board exhibit or a stand-alone exhibit, NOT both.
2. Robotics Platforms is just a fancy way to say robotics kits or robotics materials. Some types of commercial kits or platform include: Arduino Kits, EV3, Brushbot, Make, Hexy, Pushbutton Programmable Robotic Kit, Sparky, Cubelets, Robotic Arm Edge, Sparkfun Red Bot, WeDo, Multiplo, NXT, TETRIX, CEENBot and VEX.
3. Youth working individually on a robotics platform should enroll in the Platform Units. Youth should advance between units 4-6 as they feel they are progressing in their project knowledge.
4. Youth working on a team on a robotics platform should enroll in the Team Robotics Unit. Despite being on a team, the fair exhibit is meant to be completed and entered by an individual member.
5. For more information about various team competitive robotics opportunities, see this list from the Colorado 4-H STEM website.
6. Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

Class

Display Board Exhibits

1. Junk Drawer Robotics Unit 1 - Give Robotics a Hand - Junior
2. Junk Drawer Robotics Unit 1 - Give Robotics a Hand - Intermediate
3. Junk Drawer Robotics Unit 1 - Give Robotics a Hand – Senior

Stand-Alone Exhibits

4. Junk Drawer Robotics Unit 1 - Give Robotics a Hand - Junior
5. Junk Drawer Robotics Unit 1 - Give Robotics a Hand - Intermediate
6. Junk Drawer Robotics Unit 1 - Give Robotics a Hand – Senior

Exhibit will consist of the following:

- A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record
- B. **For Display Board Exhibits:** One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.
- For Stand-Alone Exhibits:** One article which you have made as a part of this unit of study (Example: marshmallow catapult, robotic arm, robotic gripper)

Display Board Exhibits

7. Junk Drawer Robotics Unit 2 - Robots on the Move - Junior
8. Junk Drawer Robotics Unit 2 - Robots on the Move - Intermediate
9. Junk Drawer Robotics Unit 2 - Robots on the Move – Senior

Stand-Alone Exhibits

10. Junk Drawer Robotics Unit 2 - Robots on the Move - Junior
11. Junk Drawer Robotics Unit 2 - Robots on the Move - Intermediate
12. Junk Drawer Robotics Unit 2 - Robots on the Move – Senior

Exhibit will consist of the following:

- A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record
- B. **For Display Board Exhibits:** One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.
- For Stand-Alone Exhibits:** One article which you have made as a part of this unit of study. (Example: clipmobile, can-can robot, gear train, es-car-go, sea hunt)

Display Board Exhibits

13. Junk Drawer Robotics Unit 3 - Mechatronics - Junior
14. Junk Drawer Robotics Unit 3 - Mechatronics - Intermediate
15. Junk Drawer Robotics Unit 3 - Mechatronics – Senior

Stand-Alone Exhibits

16. Junk Drawer Robotics Unit 3 - Mechatronics - Junior
17. Junk Drawer Robotics Unit 3 - Mechatronics - Intermediate
18. Junk Drawer Robotics Unit 3 - Mechatronics – Senior

Exhibit will consist of the following:

A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record

B. **For Display Boards:** One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.

For Stand-Alone Exhibits: One article which you have made as a part of this unit of study. (Example: forward and reverse, wall follower, breadboard, say what? build your robot)

19. Robotics Platforms Unit 4 – Beginner - Junior

20. Robotics Platforms Unit 4 – Beginner - Intermediate

21. Robotics Platforms Unit 4 – Beginner – Senior

Exhibit will consist of the following:

A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record

B. Display Board ONLY:

One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.

22. Robotics Platforms Unit 5 – Intermediate – Junior

23. Robotics Platforms Unit 5 – Intermediate – Intermediate

24. Robotics Platforms Unit 5 – Intermediate - Senior

Exhibit will consist of the following:

A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record

B. Display Board ONLY:

One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.

25. Robotics Platforms Unit 6 – Advanced – Junior

26. Robotics Platforms Unit 6 – Advanced – Intermediate

27. Robotics Platforms Unit 6 – Advanced - Senior

Exhibit will consist of the following:

A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record

B. Display Board ONLY:

One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.

28 Team Robotics Unit 7 – Junior

29. Team Robotics Unit 7 – Intermediate

30. Team Robotics Unit 7 – Senior

Exhibit will consist of the following:

A. A sturdy binder/notebook that contains the completed 4-H Robotics e-Record

B. Display Board ONLY:

One display board which you have made as a part of this unit of study. The standardize display board size 4' x 3' is to be used for 4-H projects.

D-6 Welding (Metalwork)

Project will be evaluated on the quality of information completed in the manual and e-Record (25 percent) and quality of exhibit (75 percent).

Class

31. Intro to Metalwork Unit 1 – Junior

32. Intro to Metalwork Unit 1 – Intermediate

33. Intro to Metalwork Unit 1 – Senior

Exhibit will consist of the following:

A. Completed e-Record presented in a sturdy binder/notebook

B. Exhibit the following:

1. One each: Lap, Butt and 90-degree T Joints

Requirements:

- Each joint will be made of two pieces, 3" to 4" long of 1" or 2" wide flat strap metal, between 1/8" and 1/2" in thickness
- On clean steel with no paint, oil or other finishes
- Single pass weld on one side of joint only
- Name and county on bottom of each completed joint

2. An exhibit up to 3'x3'x6', under 150 lbs.

3. Photos of the stand-alone project Construction

- Four photos of the prep work (cutting, torching, bending, fitting, etc.)
- Four photos of actual welds (individual welds)
- Four photos of finish work (no painting, no oil, no seasoning, front view, side view, top view, best overall view)

C. For an exhibit larger than 3'x3'x6' and over 150 lbs.

1. Four photos of the prep work (torching, bending, fitting, etc.)
2. Four photos of actual welds (individual welds)
3. Four photos of finish work (no painting, no oil, no seasoning)
4. Four photos must be provided that include top view, side view, front view, and best view (best view is determined by member)

D. Examples include napkin holder, coat rack, cap/hat hanger

Champion Mechanical Science \$5.00

Reserve Champion Mechanical Science \$2.50