



DIVISION 14: MECHANICAL SCIENCES

Section #1

BICYCLE

Unit 1 BICYCLING FOR FUN Jr. / Int. / Sr.

Unit 2 WHEELS IN MOTION Jr. / Int. / Sr.

Unit 3 BICYCLE SELF-DETERMINED Int. / Sr.

All exhibits will consist of the following:

- A. Completed project manual and e-Record presented in a sturdy binder/notebook.
- B. A display board illustrating a topic investigated during the project year. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).



Section #2

COMPUTERS

- 1. 4-H members may stay in a unit for more than one year. The exhibit has to be different each year.
 - 2. Youth are only allowed to enter a display board exhibit or CD or DVD or a stand-alone exhibit, not all. Be sure that the CD or DVD is package to prevent damage to it.
- Note: Not all judging locations will have computer or Internet resources available. Display items must be self-contained and capable of being judged "as is." For example: Sample printouts of code developed, multimedia projects created or Web pages/sites developed. No three-dimensional displays will be accepted.*

NEWBIE KNOW-HOW

Display Board or CD or DVD Exhibits	Jr. / Int. / Sr.
Stand-Alone Exhibits	Jr. / Int. / Sr.

INSIDE THE BOX

Display Board or CD or DVD Exhibits	Jr. / Int. / Sr.
Stand-Alone Exhibits	Jr. / Int. / Sr.

P2P—PEER TO PEER

Display Board or CD or DVD Exhibits	Int. / Sr.
Stand-Alone Exhibits	Int. / Sr.

DISCOVERING COMPUTER SCIENCE & PROGRAMMING THROUGH SCRATCH

Display Board or CD or DVD Exhibits	Jr. / Int. / Sr.
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Stand-Alone Exhibits

Jr. / Int. / Sr.

COMPUTERS IN THE 21st CENTURY

Display Board or CD or DVD Exhibits

Jr. / Int. / Sr.

Stand-Alone Exhibits

Jr. / Int. / Sr.

TEENS TEACHING TECH

Display Board or CD or DVD Exhibits

Sr.

Stand-Alone Exhibits

Sr.

All exhibits will consist of the following:

A. One sturdy binder/notebook that contains the project manual or copy of page 5 - Achievement Program Requirements with explored areas completed (page 5 of manual for Units: Newbie Know-How, Inside the Box, Peer to Peer and Teens Teaching Technology only) or the Discovering Computer Science & Programming Through Scratch manuals for that unit (Discovering Computer Science & Programming Through Scratch and Computers in the 21st Century) 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. Potential display ideas can be found in the Expand Your Memory in the manual for Newbie Know-How, Inside the Box, P2P-Peer to Peer and Teens Teaching Tech only. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board. All items must be attached to display boards.
2. A stand-alone exhibit demonstrating a skill learned or an item developed. For example, a Makey Makey keyboard or a micro controller project. All stand-alone projects are subject to risks of display at county and state fair if eligible.
3. A CD or DVD with the program or a video of the project. This CD or DVD must be playable on a PC. Be sure to package the CD or DVD to prevent damage during travel to state fair.

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



**Section #3
ELECTRICITY**

All Electric Projects will be evaluated on the quality of the information completed in the manual and e-record (25 percent) and quality of exhibit (75 percent).

UNIT 1 MAGIC OF ELECTRICITY

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. Completed 4-H Electric project manual and e-Record presented in a sturdy binder/notebook.
- B. One article or display board (not both) that 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 2 INVESTIGATING ELECTRICITY

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. Completed 4-H Electric project manual and e-Record presented in a sturdy binder/notebook.
- B. One article or display board (not both) that 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 3 WIRED FOR POWER

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. Completed 4-H Electric project manual and e-Record presented in a sturdy binder/notebook.
- B. One article or display board (not both) that 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 4 ENTERING ELECTRONICS (Senior Advanced) Sr. Only

Exhibit will consist of the following:

- A. Completed 4-H Electric project manual 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

**Section #4
GPS & MAPPING**



- 1. 4-H members can exhibit both as an individual and/or as part of a group. The exhibits need to be different –one exhibit for the individual and a different topic exhibit for the group.

LEVEL 1 SETTING OUT Jr. / Int. / Sr.

Exhibit will consist of the following two options:

- A. Completed e-record presented in a sturdy binder/notebook.
- B. Using the ‘Take Me on a Tour’ activity, create a display and map showing four to six tour sites, geo-tools used to create the map, positional data for the sites, and information about the selected sites.

OR

- C. Using information from the “What Are Geographical Tools?” activity, prepare an exhibit showing and describing ten mapping tools. Explain how the mapping tools are used and why maps are important.
- D. Posters/Maps must be presented on display board. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board. Exhibitors are encouraged to laminate all posters/maps or cover them with clear plastic film
- E. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

LEVEL 2 ON THE TRAIL Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. Completed e-record presented in a sturdy binder/notebook.
- B. Using the table from the “Take Me on a Tour” activity from Level 1, create a map showing recreational, historical or public service sites in your community. Determine if there is a need for additional community resources. Make written suggestions for what resources should be added and where they should be located on your map.
- C. Posters/Maps must be presented on a display board. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board. Exhibitors are encouraged to laminate all posters/maps or cover them with clear plastic film.
- D. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

LEVEL 3 REACHING YOUR DESTINATION Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. Completed e-record presented in a sturdy binder/notebook.
- B. Create a computer-generated map with layered data that provides information on a community need. Explain how the need was identified, how you gathered information, and your recommendations on how to solve the need. Use the template from “Take Me on a Tour” activity from Level 1, to gather data for the map.
- C. Posters/Maps must be presented on a display board. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board. Exhibitors are encouraged to laminate all posters/maps or cover them with clear plastic film.
- D. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

GROUP PROJECTS (Developed by two or more 4-H members). Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. At least a one-page story about the project including these items: purpose of map, goals, plan, accomplishments, evaluation, and how each person on the team contributed to the project.
- B. Hand drawn or computer generated map (map can be either informational or directional).
- C. Posters/Maps must be presented on a display board. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board. Exhibitors are encouraged to laminate all posters/maps or cover them with clear plastic film.
- D. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).



Section #5
MODEL ROCKETRY

UNIT
1

Note to 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 its 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"x12"x1" 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.

INTRODUCTION TO ROCKETRY

Balsa Fins Only

Jr. / Int. / Sr.

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. The 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 a 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 problems you encountered?
- D. One rocket personally built or other display related to work done at Skill Level 1.
- E. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 2

BASIC MODEL ROCKETRY

Balsa Fins Only

Jr. / Int. / Sr.

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. The 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 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 problems you encountered?
- D. One rocket personally built or display related to work done at Skill Level II.
- E. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 3 INTERMEDIATE MODEL ROCKETRY

Balsa Fins Only

Jr. / Int. / Sr.

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. The 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 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?
- D. One rocket personally built in unit or display related to work done at Skill Level III.
- E. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 4 ADVANCED MODEL ROCKETRY

Finished fins of any type

Jr. / Int. / Sr.

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. The 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 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 any problems you encountered?
- D. One rocket personally built in unit or display related to work done in Skill Level IV.
- E. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 6 DESIGNER MODEL ROCKETRY

Finished fins of any type

Jr. / Int. / Sr.

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 any problems you encountered?
- C. One rocket personally designed, built (no kits) and used in unit or display related to work done.
- D. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

Section #6

Robotics

- 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 platforms include: Arduino Kits, EV3, Brushbot, Make, Hexy, Pushbutton Programmable Robotic Kit, Sparky, Cubelets, Robotic Arm Edge, Sparkfun Red Bot, WeDo, Multipl0, 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.

JUNK DRAWER ROBOTICS UNIT 1—GIVE ROBOTICS A HAND

Display Board Exhibits
Stand-Alone Exhibits

Jr. / Int. / Sr.
Jr. / Int. / Sr.

- 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, et al.)
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

JUNK DRAWER ROBOTICS UNIT 2—ROBOTS ON THE MOVE

Display Board Exhibits Jr. / Int. / Sr.
 Stand-Alone Exhibits Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic 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-Alones 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, et al.)
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

JUNK DRAWER ROBOTICS UNIT 3—MECHATRONICS

Display Board Exhibits Jr. / Int. / Sr.
 Stand-Alone Exhibits Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic 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 part of this unit of study. (Example: forward and reverse, wall follower, breadboard, say what? build your robot, et al.)
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

ROBOTICS PLATFORMS UNIT 4—Platforms Beginner

Platforms-Beginner Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic e-record.
- B. One display board which you have made as a part of this unit of study. The standardized display board size 4' X 3' is to be used for 4-H projects.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

ROBOTICS PLATFORMS UNIT 5—Platforms Intermediate

Platforms-Intermediate Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic e-record.
- B. One display board which you have made as a part of this unit of study. The standardized display board size 4' X 3' is to be used for 4-H projects.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

ROBOTICS PLATFORMS UNIT 6—Platforms Advanced

Platforms-Advanced Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic e-record.
- B. One display board which you have made as a part of this unit of study. The standardized display board size 4' X 3' is to be used for 4-H projects.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

TEAM ROBOTICS UNIT 7

Team Robotics Jr. / Int. / Sr.

- A. A sturdy binder/notebook that contains the completed 4-H Robotic e-record.
- B. One display board which you have made as a part of this unit of study. The standardized display board size 4' X 3' is to be used for 4-H projects.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).



Section #8
 SMALL ENGINES

UNIT 1 CRANK IT UP

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. A completed Small Engines manual 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 2 WARM IT UP

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. A completed Small Engines manual 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of the display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 3 TUNE IT UP

Jr. / Int. / Sr.

Exhibit will consist of the following:

- A. A completed Small Engines manual 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 Engine manual. You may use pictures or any records you kept to provide evidence of your accomplishments and what you have learned. Label and use captions to make your display as educational as possible. The standardized display board size of 4 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of the display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent).

UNIT 4 ADVANCED ENGINES

Jr. / Int. / Sr.

Exhibit will consist of the following:

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

- A. 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
- 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 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 ft. x 3 ft. is to be used with 4-H projects. No additional items may be included in front of display board.
- C. Project will be evaluated on the quality of the information completed in the e-record (25 percent) and quality of the exhibit (75 percent)