



# Robotics

## Merit Badge Workbook

Thank you for your interest in participating in our merit badge workshop. We are very excited to be able to offer this workshop to help you complete the necessary requirements to earn your badge while also carrying out the hands-on activities in an enriching and fun way. This workbook describes the workshop's activities and prerequisites. Most of the prerequisites are research and reading activities that will better prepare you for the merit badge workshop.

**Activities we will complete in the workshop are colored blue.**

**Prerequisite requirements are colored red.**

BEFORE you attend this merit badge workshop you MUST do the following prerequisites:

**Requirement 1**

**Requirement 2**

**Requirement 3**

**Requirement 7**

Please note: The merit badge counselor will not sign "blue cards" for scouts not demonstrating completed prerequisites from this workbook. It is NOT acceptable to come unprepared to the event.

Studying the Robotics merit badge pamphlet PRIOR to attending and doing preparation work will ensure that you get the most out of the workshop opportunities. The merit badge pamphlet is a wealth of information that can make earning the merit badge a lot easier. It contains many of the answers and solutions needed or provides direction as to where you can find the answers.

Lego Mindstorms robotic kits are provided for use in the workshop. You will work on a team of three or four Scouts on Requirement 4. If you have robotics experience, be prepared to share your skills with your team.

### **Things to bring for the Robotics Merit Badge Workshop:**

1. Merit Badge Blue Card properly filled out and signed by your Scoutmaster.
2. Scout Uniform. Your Scout Uniform is required to be worn while attending Merit Badge Madness.
3. Workbook for this merit badge printed out and prerequisite requirements filled in.
4. Your Robot Engineering Notebook.\*
5. All additional supporting documentation or project work pertinent to this merit badge.
6. A positive Scouting focus and attitude.

\* Many notebook formats are suitable – a composition notebook or sectioned binder work well. Graph paper pages are particularly useful, but not essential. Note that several sections are required. See page 35 in the Robotics merit badge pamphlet.

If you have any additional questions, please feel free to contact Mark Esau by email at [markesau@hotmail.com](mailto:markesau@hotmail.com).



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## Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet. No one can add or subtract from the Boy Scout Requirements, publication #33216. Each Scout must do each requirement. The work space by each requirement is for the scout to make notes for discussing the item with the counselor, not for the full and complete answers.

Inaugural Badge Requirements: April, 2011, Workbook updated: February, 2013.

Scout's Name: \_\_\_\_\_ Unit: \_\_\_\_\_

Counselor's Name: \_\_\_\_\_ Counselor's Ph #: \_\_\_\_\_

**1. Safety.** Do each of the following:

- a. Explain to your counselor the most likely hazards you may encounter while working with robots and what you should do to anticipate, mitigate and prevent, and respond to these hazards.

Hazard: \_\_\_\_\_

Anticipate: \_\_\_\_\_

Mitigate & Prevent: \_\_\_\_\_

Respond \_\_\_\_\_

Hazard: \_\_\_\_\_

Anticipate: \_\_\_\_\_

Mitigate & Prevent: \_\_\_\_\_

Respond \_\_\_\_\_

Hazard: \_\_\_\_\_

Anticipate: \_\_\_\_\_

Mitigate & Prevent: \_\_\_\_\_

Respond \_\_\_\_\_

Hazard: \_\_\_\_\_

Anticipate: \_\_\_\_\_

Mitigate & Prevent: \_\_\_\_\_

Respond \_\_\_\_\_

Describe the appropriate safety gear and clothing that should be used when working with robotics. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- b. Discuss first aid and prevention for the types of injuries or illnesses that could occur while participating in robotics activities and competitions, including cuts, \_\_\_\_\_

\_\_\_\_\_

eye injuries,

\_\_\_\_\_

and burns (chemical or heat)..

\_\_\_\_\_

2. **Robotics industry.** Discuss the following with your counselor:

a. The kinds of things robots can do \_\_\_\_\_

\_\_\_\_\_

and how robots are best used today.

\_\_\_\_\_

b. The similarities and differences between remote-control vehicles,

\_\_\_\_\_

telerobots,

\_\_\_\_\_

\_\_\_\_\_

and autonomous robots

\_\_\_\_\_

c. Three different methods robots can use to move themselves other than wheels or tracks.

\_\_\_\_\_

\_\_\_\_\_

Describe when it would be appropriate to use each method.

\_\_\_\_\_

3. **General knowledge.** Discuss with your counselor three of the five major fields of robotics (human-robot interface, mobility, manipulation, programming, sensors) and their importance to robotics development.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

Discuss either the three fields as they relate to a single robot system \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OR talk about each field in general. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Find pictures or at least one video to aid in your discussion.

4. Design, build, program, test. Do each of the following:

- a. With your counselor's approval, choose a task for the robot or robotic subsystem that you plan to build. Include sensor feedback and programming in the task. Document this information in your robot engineering notebook \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- b. Design your robot. The robot design should use sensors and programming and have at least 2 degrees of freedom. Document the design in your robot engineering notebook using drawings and a written description \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- c. Build a robot or robotic subsystem of your original design to accomplish the task you chose for requirement 4a.

\_\_\_\_\_  
\_\_\_\_\_

- d. Discuss with your counselor the programming options available for your robot. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Then do either option 1 OR option 2

Option 1. Program your robot to perform the task you chose for your robot in 4a. Include a sample of your program's source code in your robot engineering notebook \_\_\_\_\_

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Option 2. Prepare a flowchart of the desired steps to program your robot for accomplishing the task in 4a. Include procedures that show activities based on sensor inputs. Place this in your robot engineering notebook

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e. Test your robot and record the results in your robot engineering notebook. Include suggestions on how you could improve your robot, as well as pictures or sketches of your finished robot: \_\_\_\_\_

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5. Demonstrate. Do the following

a. Demonstrate for your counselor the robot you built in requirement 4. \_\_\_\_\_

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b. Share your robot engineering notebook with your counselor. Talk about how well your robot accomplished the task,

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the improvements you would make in your next design, \_\_\_\_\_

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and what you learned about the design process \_\_\_\_\_

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6. Competitions. Do ONE of the following.

- a. Attend a robotics competition and report to your counselor what you saw and learned about the competition

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and how teams are organized and managed

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- b. Learn about three youth robotics competitions. Tell your counselor about these, including the type of competition, \_\_\_\_

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time commitment,

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age of the participants,

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and how many teams are involved.

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7. Name three career opportunities in robotics.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

Pick one and find out the education, \_\_\_\_\_

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training,

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and experience required for this profession.

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Discuss this with your counselor, and explain why this profession might interest you.

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**Online Resources** (Use any Internet resource with caution and only with your parent's or guardian's permission.)

**Boy Scouts of America:** ► [scouting.org](http://scouting.org) ► [Guide to Safe Scouting](#) ► [Age-Appropriate Guidelines](#)

**Merit Badge Books:** ► [www.scoutstuff.org](http://www.scoutstuff.org)

**Merit Badge Workbooks:** *Please don't post workbooks on your site. Please instead post links to these:*

[MeritBadge.org: http://meritbadge.org/wiki/index.php/MBW](http://meritbadge.org/wiki/index.php/MBW) -or- [usscouts.org: http://www.usscouts.org/mb/worksheets/list.asp](http://www.usscouts.org/mb/worksheets/list.asp)

### **Requirement Resources**

NASA Robotics <http://robotics.nasa.gov>

Robot Events <http://robotevents.com>

Robotics Education and Competition Foundation <http://www.robotevents.com>

Find a robotics Kit <http://boyslife.org/about-scouts/merit-badge-resources/robotics/19254/find-a-robotics-kit/>

### **General Resources**

American Society of Mechanical Engineers <http://www.asme.org>

AUVSI Foundation Robotic Competitions <http://www.auvsifoundation.org>

Carnegie Mellon Robotics Academy <http://www.cs2n.org/boyscouts>

Institute of Electrical and Electronics Engineers <http://www.ieee.org>

National Robotics Week <http://www.nationalroboticsweek.org>

RoboGames <http://www.robogames.net>

Robotics Education and Competition Foundation <http://www.robotevents.com>

Roboworld <http://www.visitroboworld.com>

Technology Student Association <http://www.tsaweb.org>

### **Additional Online Resources**

"How to Build a Robot" by Razor Robotics [http://www.razorrobotics.com/building\\_robots.html](http://www.razorrobotics.com/building_robots.html)

"How to Make a Robot" by [GoRobotics.net](http://www.gorobotics.net) <http://www.gorobotics.net/articles/how-to-make-a-robot-lesson-1>

"Robotics Tutorials" by [ElectronicTeacher.com](http://www.electronicsteacher.com) <http://www.electronicsteacher.com/robotics/robotics-tutorial/plain-robotics>

"MIT Lincoln Labs Robotics Outreach" <http://www.ll.mit.edu/outreach/ROLL.html>

"LEGO Mindstorms" <http://mindstorms.lego.com/en-us/Default.aspx>

### **Robotics Merit Badge: Get Interactive**

Get ready to unlock the BSA's first interactive merit badge resource center! Enhance your merit badge learning experience by tapping into a mind-blowing explosion of videos, games, activities, photos, the latest resources, and much more, including links to sources for robotics kits. Visit <http://www.boyslife.org/robotics>