Name  _________________________________________
Age  ___________________________________________
( as of January 1 of the current year)
Club name  _____________________________________
Club advisor  ____________________________________
County  _________________________________________

ROBOTICS 2
EV3N
More

THE Ohio State University
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES
Robotics 2: EVEN MORE requires the use of the same EV3 LEGO® kit used in Robotics 1 with EV3. It is intended for youth who are already proficient in building a LEGO® EV3 robot. Kits are available from LEGO® Education, which offers a special bundle that includes the robot, software, rechargeable battery, and storage bin. Youth who take this project also need access to a computer and the internet.

Every activity begins with construction of a special robot configuration. Instructional videos are available to 4-H members via the Ohio 4-H Robotics web page at ohio4h.org/robotics.
NOTES TO THE PROJECT HELPER

Congratulations! A 4-H member has asked you to serve as a project helper. You may be a parent, relative, project leader, friend, club advisor, or another person important in the 4-H member’s life. Your duties begin with helping the youth create and carry out a project plan, as outlined in the Member Project Guide. This is followed by helping the youth focus on each activity, providing support and feedback, and determining what was done well, what could have been done differently, and where to go next.

As a project helper, it is up to you to encourage, guide, and assist the 4-H member. How you choose to be involved helps to shape the 4-H member’s life skills and knowledge of the importance of robotics.

Your Role as Project Helper

Your contributions are critical to delivery of the 4-H program, which is committed to providing experiences that strengthen a young person’s sense of belonging, generosity, independence, and mastery. Your interactions should support positive youth development within the framework of the Eight Essential Elements (also known as the Eight Key Elements):

1. A positive relationship with a caring adult
2. An inclusive environment
3. A safe emotional and physical environment
4. Opportunity for mastery
5. Engagement in learning
6. Opportunity to see oneself as an active participant in the future
7. Opportunity for self-determination
8. Opportunity to value and practice service to others

For more information on the Eight Essential Elements, please refer to the Volunteer Handbook available online at ohio4h.org. On a practical level, your role as a project helper means you will . . .

- Guide the youth and provide support in setting goals and completing this project.
- Encourage the youth to apply knowledge from this project book.
- Serve as a resource person.
- Encourage the youth to go beyond the scope of this 4-H project book to learn more about robotics.

What You Should Know About Experiential Learning

The information and activities in this book are arranged in a unique, experiential fashion (see model). In this way, a youth is introduced to a particular practice, idea, or piece of information through an opening (1) experience. The results of the activity are recorded on the accompanying pages. The member then (2) shares what he or she did with the project helper and (3) processes the experience through a series of questions that allow him or her to (4) generalize and (5) apply the new knowledge and skill.
Welcome to *Robotics 2: EV3N More*! This project is designed for 4-H members of all ages who have advanced-level robotics skills and who have completed *Robotics 1 with EV3*. All activities are based on the LEGO® EV3 system.

This project is designed as an individual project, although many 4-H members decide to complete it in small groups.

The LEGO® EV3 robot that was constructed for Robotics 1 is required, and access to a computer and the internet are necessary.

The project can easily be completed in one year. Each activity begins with a short video, but you will need an hour or two to complete each one.

Members who want to continue in robotics are encouraged to design their own self-determined robotics projects with the Robotics Master, available at [ohio4h.org/robotics](http://ohio4h.org/robotics).

Check your county’s project guidelines (if any) for completion requirements in addition to the ones below, especially if you plan to prepare an exhibit for the fair.

**PROJECT GUIDELINES**

**Step 1:** Complete all seven activities.

**Step 2:** Take part in at least two learning experiences.

**Step 3:** Become involved in at least two leadership/citizenship activities.

**Step 4:** Write a project summary and take part in a project review.
STEP 1:

Project Activities

Complete all seven activities. The More Challenges activities are optional. When you begin an activity, jot down the date you start it. When you finish an activity, review your work with your project helper. Then ask your project helper to initial and date your accomplishment.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DATE COMPLETED</th>
<th>PROJECT HELPER INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Get a Grip</td>
<td></td>
<td></td>
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<tr>
<td>2. Data Driven Decisions</td>
<td></td>
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<tr>
<td>3. What Kind of World Do We Live in?</td>
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<td>4. We’ve Got Trouble</td>
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<td>5. And More Trouble</td>
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<tr>
<td>6. Math-a-Mania</td>
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<tr>
<td>7. That Seems Logical</td>
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Learning Experiences

Learning experiences are meant to complement project activities, providing the opportunity for you to do more in subject areas that interest you. What are some learning experiences you could do show the interesting things you are learning about? Here are some ideas:

- Attend a clinic, workshop, demonstration, or speech related to engineering or robotics.
- Prepare an announcement for school, radio, television, or the internet on an event related to engineering or robotics.
- Help organize a club meeting based on this project.
- Go on a related field trip or tour.
- Host a workshop to share tips and tricks about working on robots and other science, technology, engineering and math subjects.
- Prepare your own demonstration, illustrated talk, or project exhibit.
- Participate in county judging.

Once you have a few ideas, record them here. Complete **at least two** learning experiences. Then, describe what you did in more detail. You may add to or change these activities at any time. Ask your project helper to date and initial in the appropriate spaces below.

<table>
<thead>
<tr>
<th>PLAN TO DO</th>
<th>WHAT I DID</th>
<th>DATE COMPLETED</th>
<th>PROJECT HELPER INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
<td>Showed club members the tools and supplies needed to assemble a robot.</td>
<td>5/5/YR</td>
<td>T.D.</td>
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</tbody>
</table>
## STEP 3:

### Leadership and Citizenship Activities

Choose **at least two** leadership/citizenship activities from the list below (or create your own) and write them in the table below. Record your progress by asking your project helper to initial next to the date as each one is completed. You may add to or change these activities at any time. Here are some examples of leadership/citizenship activities:

- Teach someone about programming a robot.
- Help another member prepare for his or her project judging.
- Help organize a club field trip to a science museum or to a manufacturing plant that has robotics.
- Organize a science, engineering, or technology event in your area.
- Encourage someone to take a science, engineering, or technology project.
- Arrange for someone from a local manufacturing firm to speak to your club about robotics.
- Plan your own leadership/citizenship activity.

<table>
<thead>
<tr>
<th>LEARNING/CITIZENSHIP ACTIVITIES</th>
<th>DATE COMPLETED</th>
<th>PROJECT HELPER INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organized a club field trip to the robotics lab at the local middle school.</td>
<td>5/5/YR</td>
<td>T.D.</td>
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STEP 4: Project Review

All finished? Congratulations! After you’ve completed the activities in this book you are ready for a project review. This process will help assess your personal growth and evaluate what you have learned.

Use this space to write a brief summary of your project experience. Be sure to include a statement about the skills you have learned and how they may be valuable to you in the future.

Now...

Now, set up a project evaluation. You can do this with your project helper, club leader, or another knowledgeable adult. It can be part of a club evaluation or it can be part of your county’s project judgings.
ACTIVITY 1

Get a Grip

In Robotics 1 with EV3 you built a robot that could drive around, detect an object with a touch sensor, look for colors, detect and follow a black line, and sense how far it was from an object using an ultra-sonic sensor. Whew! That was a lot of learning! Believe it or not, you have just scratched the surface of all the things your little robot can do.

The robot you built in Robotics 1 with EV3 is referred to as the driving base. It is called a mobile robot or rover, because it can move from place to place under its own power. Mobile robots can have wheels, like your robot, or tank treads or perhaps even legs. Regardless of how they get around, mobile robots are very exciting and fun to work with.

Now, we want to make your robot rover a bit more useful. Your robot can drive around and get from place to place but . . . then what? The poor robot has no arms. You need to add a third motor with a collection tool so your robot can interact with its environment in a meaningful way.

If your collector arm is not already built, refer to the kit’s instructions to build it. They were included with your kit and are also available at ohio4h.org/robotics. To program your robot, go to the same web page and watch the video called Activity 1: Get a Grip.

All set? Try to have your robot retrieve different kinds of objects. Good examples include a spoon, golf ball, ping-pong ball, small book, a pen, or pencil.

Can you modify your collector to deal with different objects?

Record your success in the table below and make notes about any special considerations.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>SUCCESS? (Yes or No)</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
LEARNING OUTCOMES
- **Project skill:** Building and programming a robot to pick up and move objects
- **Life skill:** Mastering technology
- **Educational standard:** 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- **Success indicator:** Programs a LEGO® EV3 robot to pick up and move objects

MORE CHALLENGES
*Create a program for your robot and collector that collects several objects and brings them back to a single location.*

**Talking It Over**

**SHARE** Why do you think mobile robots seem more exciting than robots that cannot move from place to place?

**REFLECT** When you tried to have your robot collect different objects, which ones worked and which ones did not? Can you make a general rule about what it can or cannot collect?

**GENERALIZE** What challenges would you face if you tried to design a collection device that could pick up whatever it is given?

**APPLY** What other types of attachments could you create to make your rover more useful?
BACKGROUND

The collector is a type of end effector. End effectors are the items at the end of a robotic arm. Typically this device is what really makes the robot useful or effective. There are many different types of end effectors for robots. Some, such as grippers, electro magnets and suction cups, are used to attach to or grip objects and move them from one place to another. Other specialized end effectors, such as welders, paint sprayers, grinders and drills, enable robots to modify a part as a step in the assembly line process. These end effectors are called process tooling because they are part of the manufacturing process. You can see videos of many different kinds of industrial robotic arms and end effectors at robots.com.

Did you know?

Shadow Robot Company in the United Kingdom has developed one of the worlds most advanced robot hands. The Shadow Dexterous Hand-C6 has 24 movements that imitate the human hand movement and sensitivity as closely as possible. See more at shadowrobot.com.
The use of robots in industry is becoming common, with specialized robots performing all sorts of functions faster and more reliably than humans. RobotWorx, a company in Marion, OH, that supplied these images, is dedicated to helping other companies integrate robots into their production processes. It even buys and sells robots and robot parts. To learn more, go to used-robots.com.
### SUMMARY OF LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>PROJECT SKILL</th>
<th>LIFE SKILL</th>
<th>EDUCATIONAL STANDARD*</th>
<th>SUCCESS INDICATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Get a Grip</td>
<td>Programming a robot to make a complex decision</td>
<td>Mastering Technology</td>
<td>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
<td>Programs a LEGO® EV3 robot to pick up and move objects</td>
</tr>
<tr>
<td>2. Data Driven Decisions</td>
<td>Creating a program to make sensor values control motor speed</td>
<td>Mastering Technology</td>
<td>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.</td>
<td>Programs a LEGO® EV3 so that its speed is based on input from the ultrasonic sensor</td>
</tr>
<tr>
<td>3. What Kind of World Do We Live In?</td>
<td>Programming a robot to display sensor data</td>
<td>Understanding Systems</td>
<td>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
<td>Identifies and corrects problems in the performance of a LEGO® EV3 robot by displaying data values in real time</td>
</tr>
<tr>
<td>4. We’ve Got Trouble</td>
<td>Identifying and correcting problems in robot performance by displaying data values in real time</td>
<td>Solving Problems</td>
<td>3-5-ETS1-3. Plan and carry out fair tests in which variable are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
<td>Programs a LEGO® EV3 robot to create, store, and retrieve a data variable</td>
</tr>
<tr>
<td>5. And More Trouble</td>
<td>Programming a robot to create, store, and retrieve a data variable</td>
<td>Solving Problems</td>
<td>3-5-ETS1-3. Plan and carry out fair tests in which variable are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
<td>Programs a LEGO® EV3 robot to create, store, and retrieve a data variable</td>
</tr>
<tr>
<td>6. Math-a-Mania</td>
<td>Programming a robot to do a calculation using values from sensors</td>
<td>Understanding Systems</td>
<td>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.</td>
<td>Programs a LEGO® EV3 robot to do a calculation using values from the light sensor</td>
</tr>
<tr>
<td>7. That Seems Logical</td>
<td>Programming a robot to make a complex decision</td>
<td>Reasoning</td>
<td>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.</td>
<td>Programs a LEGO® EV3 robot to make a complex decision</td>
</tr>
</tbody>
</table>

* The educational standards cited here are from the Next Generation Science Standards. They are available in their entirety at nextgenscience.org.