WISCONSIN 4-H ROBOTICS RALLY

2012

INFORMATION & REGISTRATION PACKET

USDA

UW Extension Cooperative Extension

4-H STEM Science, Technology, Engineering + Math WISCONSIN

2012 WISCONSIN 4-H ROBOTICS RALLY

INTRODUCTION

4-H Science programs reach more than 5 million youth with hands-on learning experiences to encourage young minds and help fill our nation's shortage of young leaders proficient in science, technology, engineering and math (STEM) disciplines. America faces a future of intense global competition with a startling shortage of scientists. In fact, only 18 percent of U.S. high school seniors are proficient in science (NAEP 2005) and a mere 5 percent of current U.S. college graduates earn STEM degrees compared to 66 percent in Japan and 59 percent in China.

To address increased demand for science and technology professionals, 4-H is working to reach a bold goal of engaging one million new young people in science programs by 2013. Currently, 4-H Science programs reach more than 5 million youth with hands-on learning experiences to ensure global competitiveness and prepare the next generation of science, engineering, and technology leaders.

In Wisconsin, this mission continues with local robotics programming and challenges, like the ones outlined in this booklet. This easy-to-use guide describes everything you need to know to participate in the **2012 Wisconsin 4-H Robotics Rally**. Research has shown that robotics provides a unique learning experience for youth to design, build and program machines using their own creative imagination. Robotics also gives youth the opportunity for hands-on learning and builds skills necessary to succeed in the 21st century workforce. The teamwork, critical thinking and problem solving skills acquired through participating in the **Wisconsin 4-H Robotics Rally** will aid youth in becoming confident and innovative adults no matter what career field they may enter in the future.

4-H's approach to STEM is comprehensive and holistic—from agriculture to robotics to alternative energy—youth are learning about highly relevant complex systems and issues that will ensure their contributions to their communities today and their success as global leaders tomorrow.

On behalf of the Wisconsin 4-H Robotics Committee, I want to thank you for your participation in this extraordinary event and best of luck in the Rally competition.

Sincerely,

Joanna M. Skluzacek, Ph.D.
4-H STEM Specialist
University of Wisconsin-Extension

2012 WISCONSIN 4-H ROBOTICS RALLY

REGISTRATION FORM

The Wisconsin 4-H Robotics Rally is a competition specifically designed to increase accessibility and awareness of robotics programs while providing recognition to youth for their accomplishments. The Wisconsin 4-H Robotics Rally is open to all youth in 3rd grade – 12th grade. The first 12 teams whether multiple or individual to sign up for the county competition will be allowed to compete. Registration is first-come, first served. Registration deadline is **30 days** before the event in Brown County.

STEP #1: CHALLENGE LOCATION *(Check Only One)*

❒ Brown County UW-Extension Office
1150 Bellevue Street
Green Bay, WI 54302
March 3, 2012 (9:00 am – 1:00 pm)

STEP #2: SELECT A PARTICIPATION OPTION *(Check Only One)*

❒ Option A: Individual Competition (1 Youth Member and 1 Adult Member)

❒ Option B: Group Competition (2-5 Youth Members and 1-2 Adults Member(s))

❒ Option C: Individual or Group Observation (not participating in competition*)

*Option C is only for teams or individuals that want to observe the challenges, but not participate. Individuals or Teams that register under option C will not receive a t-shirt and do not require registration fee)

STEP #3: SELECT A TEAM NAME: My / Our Team Name is the:

_____

STEP #4: COMPLETE THE ROSTER *(Please Print)*

Youth Member Name(s)	Grade	Gender	Race*	Ethnicity**	T-shirt Size
					S M L XL
					S M L XL
					S M L XL
					S M L XL
					S M L XL
Adult Member Name(s)	**Grade**	**Gender**	**Race***	**Ethnicity****	**T-shirt Size**
					S M L XL
					S M L XL

***Race Options**
White
Black or African American
American Indian or Alaskan Native
Asian
Native Hawaiian or Other Pacific Islander
More than one Race
Undetermined

****Ethnicity Options**
Hispanic or Latino
Not Hispanic or Latino

STEP #5: TEAM CONTACT INFORMATION *(Adults Only)*

Last Name:_____ First Name_____M.I.___

Street / Mailing Address_____

City_____ State_____ Zip_____

Home Phone_____ Cell Phone_____

Primary E-mail Address_____

STEP #6: REGISTRATION AND PAYMENT INFORMATION

The cost to participate in the Wisconsin 4-H Robotics Challenge is $10 per participant (including adults) per location. Individuals may only compete at one location.

Use the following formula to calculate your team registration fees:

Number of Youth	+	Number of Adults	=		x $10	=	$

Mail this completed form including a check made payable to:

Brown County 4-H Leaders Association
1150 Bellevue Street
Green Bay, WI 54302

(NORTHEAST REGION)

FOR MORE INFORMATION CONTACT

Judy Wolniakowski
4-H Youth Development Educator
Brown County UW-Extension
Phone: 920-391-4613
Fax: 920-391-4617
Email: judith.wolniakowski@ces.uwex.edu

REGISTRATION DUE 30 DAYS PRIOR TO EVENT
SPACE IS LIMITED TO THE FIRST 12 PER RALLY ENTRIES.

2012 WISCONSIN 4-H ROBOTICS RALLY

INFORMATION

Event Overview

This opportunity to showcase their skills in the field of robotics is available to all youth in 3rd grade – 12th grade residing in the State of Wisconsin. The organizers and judges would like this to be a positive experience for all; and for all participants, youth and adults alike, to have fun. The event is designed to celebrate the accomplishment of 4-H youth and to encourage them to greater heights.

All the challenges in this packet can be completed by following the building instructions in the LEGO® MINDSTROMS® Education NXT Base Set. If you choose to design and build your own robot, you will not be deducted or awarded points. Points are awarded entirely on the performance of the robot and the results of the written test (explained later in this document).

This packet contains all the information needed to compete at the 2012 Wisconsin 4-H Robotics Competition. This competition consists of two parts, a written test and three challenges for the team robot to complete. Each challenge carries 100 points. The written test carries 20% of the final score. Each member of the team must complete the test and the team will be awarded the average score. The written test will consist of 10 questions and must be completed in 15 minutes. Maximum score for the written test will be 20. Sample questions and solutions are provided at the end of this packet. Questions in the written test will have the same format and level of complexity as those provided in the sample.

- Each team has 5 minutes to complete each challenge, this includes retries.
- Any time a robot has stopped, left the field, or otherwise failed the task the team can restart the challenge.
- The team must signal to the judge when starting a challenge and when starting a retry.
- The highest score achieved from all tries will be awarded to the team.

Robotics Set and Accessory Specifications

Teams will need to purchase the LEGO® MINDSTROMS® Education NXT Base Set. This can be bought online at http://www.legoeducation.us/store/ (**Product ID:** W979797). Teams will need to purchase LEGO® MINDSTORMS® Education NXT-G Software 2.1 for their robot (**Product ID:** W900080). However, teams using earlier versions of this software will be able to do so. It must be noted that sets purchased from stores other than the online LEGO® Education store have different names. If the set is purchased from a location other than LEGO® Education online store or product catalog, it will be identified as the LEGO® MINDSTORMS NXT 1.0 or 1.1. The NXT 1.0 comes with the programming software and many extra parts which can be purchased

separately at the LEGO® Education store by ordering the LEGO® MINDSTORMS Educations Resource Set (**Product ID** W979695). You do *not* need the LEGO® MINDSTORMS Educations Resource Set components to participate in this competition.

Items to Bring to the Rally

All registered teams need to have the following materials in order to participate in the Wisconsin 4-H Robotics Challenge:

Required items:

1. Pre-built robot
2. A printed copy of programming code for each challenge.
3. A laptop with LEGO® MINDSTORMS® Education NXT Software installed
4. USB cable for program download
5. Markers or black electrical tape, rulers, enough poster board to create all 3 challenge fields, scissors etc. for creating the playing fields

Suggested Items:

1. Extra batteries or charger for Mindstorms NXT robot
2. Power strip
3. Extension cord (three prong with ground)

Eligibility

1. Counties and youth groups can send as many teams as they like. Teams will consist of 2-5 youth and an adult. During the Robotics Rally event, the adult must not coach, advise or otherwise communicate with his/her team members. Youth can participate as individuals. However, it must be noted that the individuals will be competing against teams and there is no separate category for individual competitors.
2. This event is open to all youth in 3rd grade – 12th grade, irrespective of 4-H enrollment.

Robotics Rally Overview and General Rules

1. The LEGO® Mindstorms Education NXT will be the platform used for this competition. While this is not meant to be an endorsement for LEGO® products, it is the most accessible and inexpensive technology available at this time.
2. Youth will bring one built and programmed robot, with appropriate attachments, to the competition. Teams are allowed to bring more than one robot. Attachments can be fixed or removed between each challenge.
3. Only LEGO® parts can be used as attachments to the robot.
4. Software programs must be downloaded into the NXT robot via the USB cable.

5. Bluetooth function must be disabled on the robot. The use of Bluetooth® for program downloads or the use of iTouch® or iPhone® apps for remote programming is prohibited.
6. There are three challenges with increasing levels of difficulty. A grading rubric has been provided with each challenge.

Creating the Playing Fields:

1. Teams will use white poster board (22"x28") for creating their robot's playing fields.
2. There is a diagram with all necessary dimensions provided with each challenge. Teams must reproduce this diagram on the poster board.
3. Each playing field must have an *approximately* 1" thick line drawn along its perimeter. This can be drawn either with a black marker or created by using back electrical tape. The robot must remain within this black perimeter at all times. All lines on the field must be approximately 1" wide. For optimal robot performance, all the lines on the field must be either black electrical tape (whose diameter is less than 1") or black marker, and not a combination of both. The playing fields provided on the day of the competition will use black electrical tape.
4. The dimensions of the start box for the robot will always be 12"x8."
5. Teams will be handed a judging schedule at the check-in table.
6. After check-in at the Robotics Rally site, teams will gather in a room where they will be provided with a slightly modified schematic of the field for Challenge 1, which they must reproduce on the provided poster board. Teams will then re-program their robot to operate in the modified playing field. These boards will serve as practice boards for the teams to prepare their robot prior to entering the round for judging. Teams will have 30 minutes in which to do this. At the end of this time, teams will be called up to the judging stations for robot performance judging.

   Please note that the modifications will be restricted to a change in dimensions and/or direction for the robot to follow. The basic concept of each challenge will remain the same. Please refer to event schedule provided in this packet. After the completion of the Challenge 1 round, teams will begin working on Challenge 2 and similarly for Challenge 3.
7. Standardized fields will be provided by 4-H staff at judging stations. Thus, teams will not be using the practice fields they created in rule # 6 above for judging.

Robot Performance Judging:

1. Each team will have a **total of 5 minutes** to showcase their robot's performance in **each Challenge**. Use of this time is up to the team. There will be five minutes given to teams for changeover (i.e. one team leaving the judging station and the other entering and setting up). Volunteers will be on hand to guide teams from the practice area to their judging station.

2. One team member should raise his or her hand to alert the judge and timekeeper that the team is ready and subsequently when starting a retry.
3. While the robot is in action, team members must not touch the playing field. Touching the robot during a challenge, other than to re-start the challenge (or to catch it if it is falling off the table!) will result in disqualification.
4. The robot must stay within the boundaries of the designated playing field. The boundaries are black lines approximately one inch thick along the edges of the poster board. If the entire robot goes beyond the boundaries, the timer will be stopped. It will be up to the team whether they wish to re-start their Challenge. The highest score achieved from all tries will be awarded to the team. If they decide to stop, they will achieve whatever points gained thus far in their robot's performance. **Team members must understand this rule.**
5. Each Challenge carries a maximum of 100 points, five of which are awarded for handing in an annotated printout of their programming code.
6. The final score for each team will be calculated as follows:

   Final Score = 0.80 x Average of (Max Team score on Challenge 1 + Max Team score on Challenge 2 + Max Team score on Challenge 3) + Team average of Written Test.
7. Awards will be given to the top three teams for adults and youth on the team. Top teams or individuals will receive a medal. First – Gold, Second – Silver, and Third – Bronze.
8. Only the contesting team, judges, timekeepers and competition officials will be allowed in the designated judging area during judging. Coaches and family members can observe the Performance judging from outside the judging area.
9. The decisions of the judge(s) will be final and binding

Robotics Rally Tentative Schedule

8:00 am – 8:30 am	Team Registration
8:30 am – 8:45 am	Welcome and Introductions
8:45 am – 9:15 am	Challenge # 1 Field Creation and Judging Preparation
9:15 am – 9:45 am	Challenge # 1 Judging
9:45 am – 10:15 am	Challenge # 2 Field Creation and Judging Preparation
10:15 am – 10:45 am	Challenge # 2 Judging
10:45 am – 11:15 am	Challenge # 3 Field Creation and Judging Preparation
11:15 am – 11:45 am	Challenge # 3 Judging
11:45 am – 12:10 pm	Written Examination and Evaluation
12:10 pm – 12:30 pm	Awards

Treatment of Judges, Timekeepers and Competition Officials

Our judges, timekeepers and competition officials have been trained and are professional in their attitudes and behaviors. They are, however, human, and participating in this tournament as volunteers. Please appreciate the time that they are giving to celebrate the achievements of the participating youth. The ruling of a judge, timekeeper or official is **not** up for debate. Arguing with the judges is unacceptable behavior.

Resources that can help teams prepare for the 4-H Robotics Rally:

1. LEGO® Mindstorms® NXT website with technical support, community and general information www.mindstorms.lego.com

2. Online tutorials for NXT-G programming: http://www.ortop.org/NXT_Tutorial/

3. This site provides examples of robots you can build with sample programs http://www.nxtprograms.com/

4. The programming software, LEGO® Mindstorms Education NXT-G includes building and programming tutorials. If you click on the 3-module straight beam on the upper right hand corner of the screen, you will open up the Robotics Educator. You can then click on individual tutorials that provide step-by-step instructions. Hovering over an object on the screen will allow you to read its name and function. Hovering over an object will also result in a more detailed description to appear in the 'little help' tab in the bottom right side of the screen. Detailed descriptions can be accessed from the little Help tab by clicking on the link provided which will connect you to web-based help pages.

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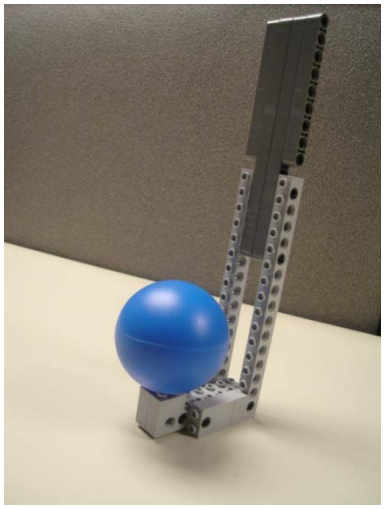
CHALLENGE #1 - Field Goal

Description:



The purpose of this challenge is to have your robot move within a designated area and to score a 'goal.' To score the goal the robot must shoot the ball placed in the center of the field, facing the start box. The ball must be placed on the ball stand which you can build using the instructions on page 62 of the building instruction booklet found in your LEGO® Mindstorms Education NXT set. Place the ball and stand in the middle of the field.

Please refer to the following page for a schematic of your playing field. You will need two poster boards to reproduce this field.

The robot should touch all corner lines of the field. The robot should shoot the ball from center box outside the field.

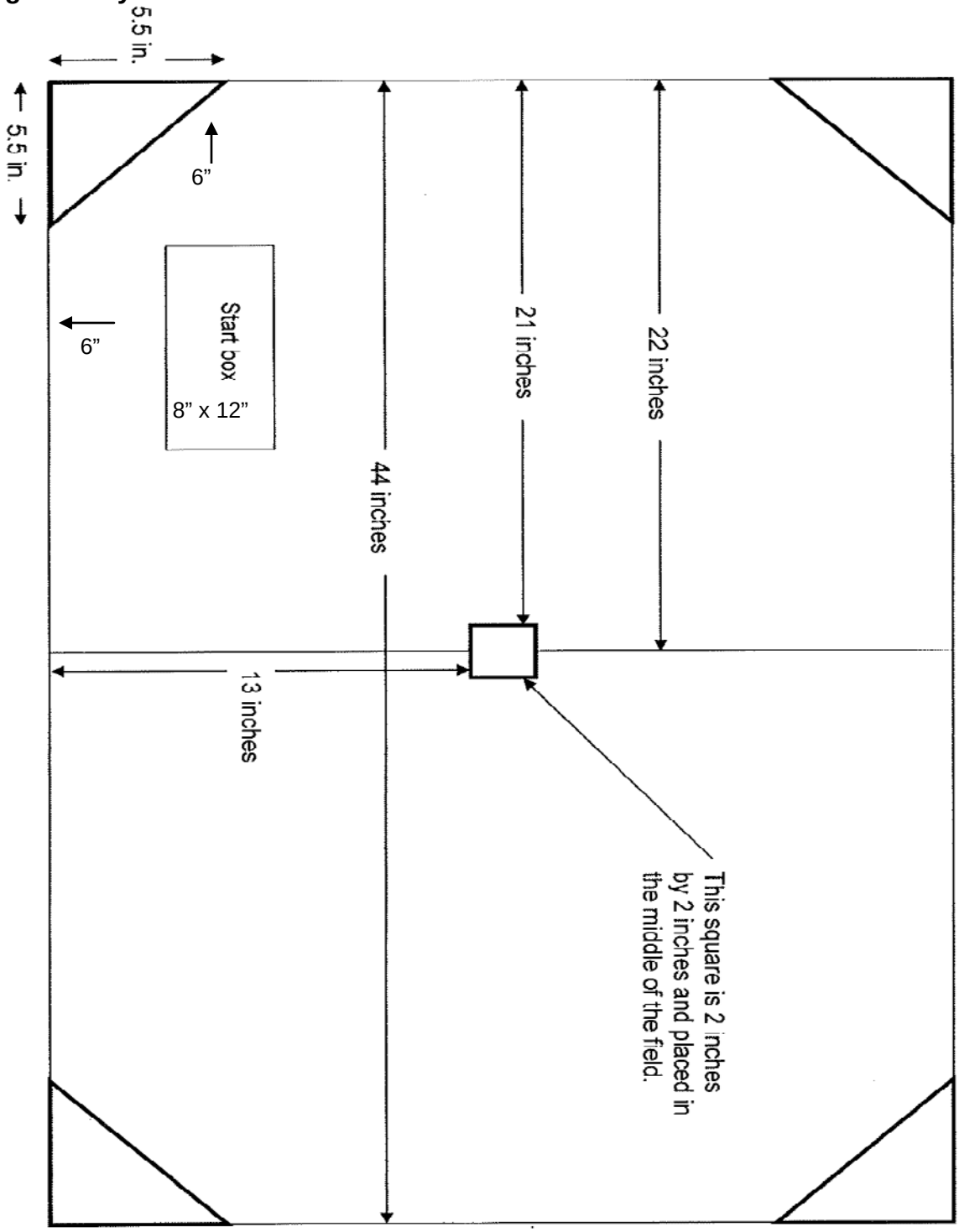
Rules:

1. At the start, the robot must stand completely inside the start box.
2. The robot must be set in motion with the clap of a hand.
3. The robot must now proceed to access each of the corners of the field. For maximum points, the robot must have two wheels within the boundary of each corner of the field without leaving the field.
4. The corners can be accessed in any order but all four must be crossed
5. At some time during the routine, the robot must approach the ball stand placed at the center square and score a goal by shooting the ball out of the field.
6. At the end of the routine the robot must return to the start box and must announce in some way that it has completed the task. For maximum points the robot must be entirely within the start box.
7. Each team has 5 minutes to complete this challenge including retries

Developed by Michelle Grimm, Taylor County 4-H Youth Development Agent, University of Wisconsin-Extension.

Diagram of Playing Field

Diagram may not be to scale.



4-H Robotics Rally Grading Rubric – Challenge # 1: Field Goal

		Points Available	Points Gained
1	At the start, the robot must stand completely inside of the start box.	5	
2	The robot must be set in motion at the clap of a hand.	10	
3	Once the robot enters the field, at no time must any part of the robot go beyond the boundaries of the 'field.'	10	
4	The robot must cross both wheels into each corner of the field without leaving the field. The corners can be done in any order but all four must be crossed. (Note: accessing each corner carries 10 points. 5 points will be allocated if the robot just breaks the plane, & the whole 10 if two wheels cross the boundary of the corner).	40	
5	At same time, during the routine, the robot must shoot the ball from the middle of the field outside the field.	10	
6	After accessing all 4 corners and shooting the ball out of the field, the robot must return to the start box.	10	
7	The robot must announce in some way that it has completed the task.	10	
8	Submitted an annotated printout of the programming code.	5	
	Total	**100**	

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CHALLENGE #2 - Breakfast Bot

Description:

Sensors can be used to help robots detect and avoid a variety of obstacles. This *Breakfast Bot* needs to travel through the *kitchen challenge field* where it will avoid common breakfast food and beverage containers.

Rules:

1. The *kitchen challenge field* will be 44" by 56" (you will need to join 4 poster boards together).

2. The *Breakfast Bot* must begin in the *Start Box* and end in the *Start Box.* The *Start Box* dimensions are 8" wide (side-to-side) and 12" long (front-to-back).

3. The *Breakfast Bot* will detect *Obstacle 1,* a cereal box, with the ultrasonic sensor. The cereal box dimensions must be between 10.5 and 12.5 inches tall, 6.5 and 8.5 inches wide, and 2.5 and 3.5 inches deep.

4. The *Breakfast Bot* will do a reverse turn and travel backwards where it will use the touch sensor to detect *Obstacle 2,* a gallon milk plastic bottle filled with water.

5. The *Breakfast Bot* will move forward to the midline of the kitchen challenge field, turn and continue forward until it detects *Obstacle 3*, a cardboard half-gallon juice or milk carton, using the ultrasonic sensor.

6. The *Breakfast Bot* will turn and continue forward to the Start Box.

7. The *Breakfast Bot* will turn and stop. When it finishes, the entire *Breakfast Bot* must be in the *Start Box* and facing the same direction it started for maximum points.

Developed by Judy Wolniakowski, Brown County 4-H Youth Development Educator, University of Wisconsin-Extension.

Kitchen Challenge Field

Dimensions: 44" x 56"

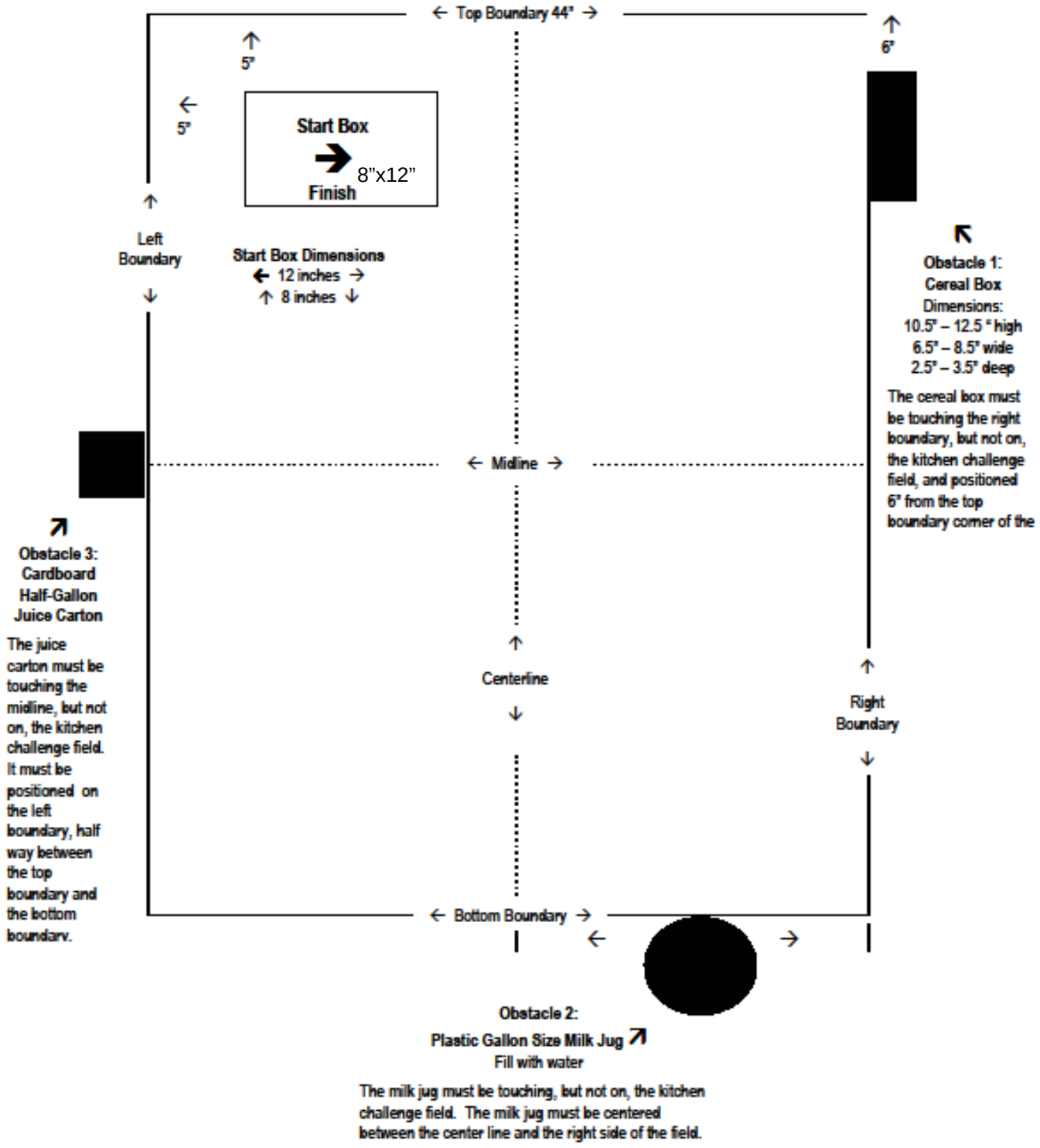

Diagram may not be to scale.

4-H Robotics Rally Grading Rubric – Challenge # 2: Kitchen Bot

Scoring		Points Available	Points Earned
1.	The robot must begin in the *Start Box.*	5	
2.	The robot must detect *Obstacle 1* with the *Ultrasonic Sensor.*	5	
3.	The robot must travel backwards.	20	
4.	The robot must touch *Obstacle 2* with the *Touch Sensor.*	15	
5.	The robot must travel to the midline and turn.	20	
6.	The robot must detect *Obstacle 3* with the *Ultrasonic Sensor.*	15	
7.	The robot will return to the *Start Box.*	10	
8.	The robot will end in the *Start Box* facing the same direction it started.	5	
9.	Submitted an annotated printout of the programming code.	5	
	Total:	**100**	

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PRACTICE CHALLENGE #3 -Data Bot

Description:

Robots are used to enter places that cannot be accessed by humans and collect data, e.g. entering water pipes to detect leaks. Your *Data Bot* will have to enter a 'dangerous' region on the playing field, find a black line and measure its length.

Rules:

1. The *Data challenge field* will be 28" by 44" (you will need to join 2 poster boards together).
2. The robot must start in the 'start box.'
3. The robot must find and enter the data collection area. The data collection area entrance will be a 6" wide passage between two weighted cereal boxes of dimensions 10.5" tall, 6.5" wide, and 2.5" deep. For maximum points the robot must detect the entrance using sensors; however, the robot can use dead reckoning (which is defined as navigation using only previously set measurements and no input from sensors).
4. Once inside the data collection area, the robot must find a 1" thick black line.
5. The robot must then follow the line, following all the turns.
6. At the end of the line, the robot must display the length of line on its screen. The length can be displayed either in inches or degrees. An approximate length will also be acceptable.

Developed by Maria Habib, Waukesha County 4-H Youth Development Agent, University of Wisconsin-Extension.

Diagram of Playing Field

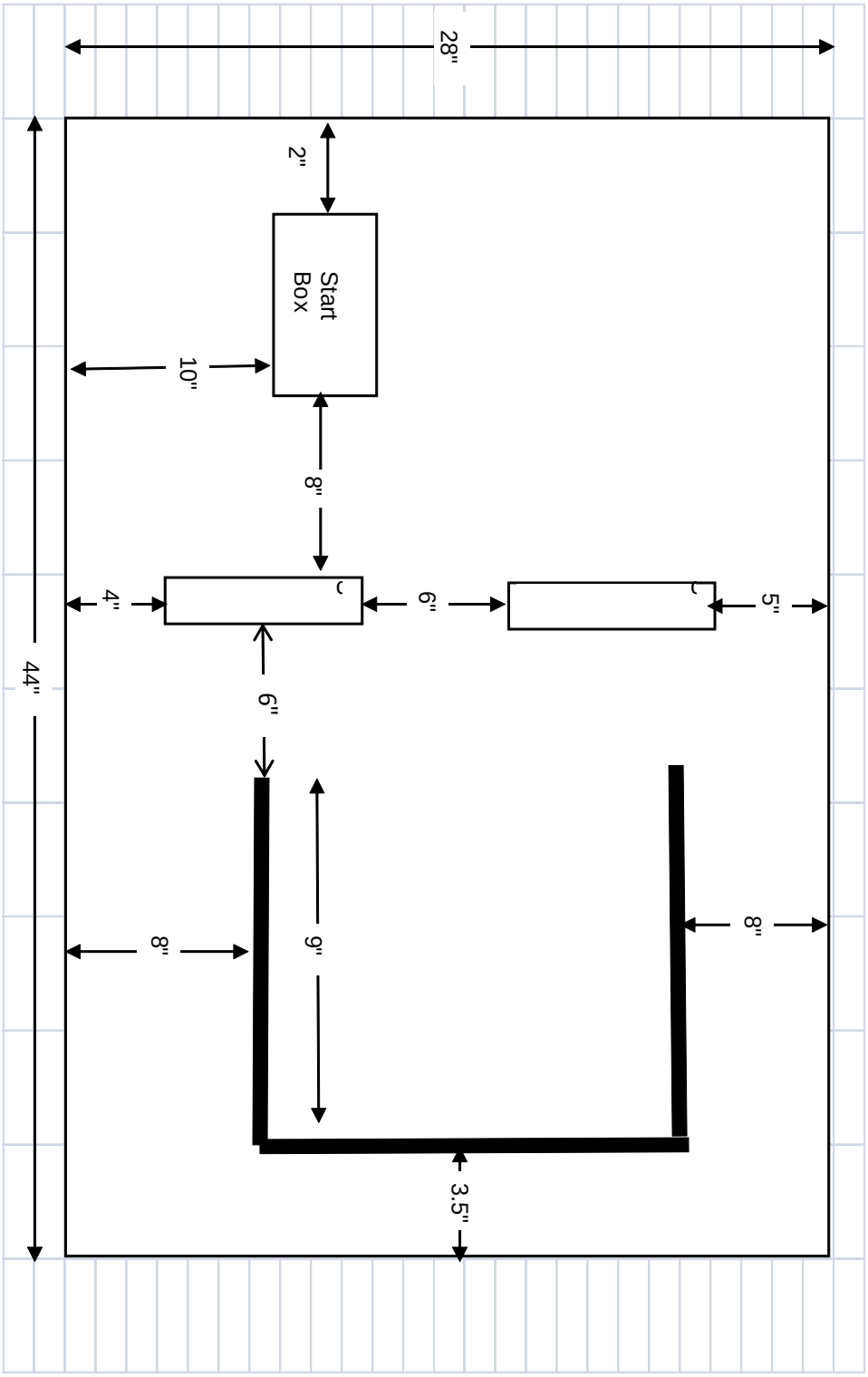


Diagram may not be to scale

4-H Robotics Rally Grading Rubric – Challenge # 3: Data Bot

Scoring		Points Available	Points Earned
1.	The robot must begin in the *Start Box.*	5	
2. a	The robot must enter the data collection area without knocking down the cereal boxes.	5	
2. b	**If** the robot detects the entrance to data collection area with the *Ultrasonic Sensor*	20	
2. c	**If** the robot enters the data collection area by dead reckoning	15	
3.	The robot must find the black line	15	
4.	The robot must follow the black line, including all turns	15	
5.	The robot must stop at the end of the line	15	
6.	At the end of the line, the robot must display the length of the line in inches or degrees.	20	
7.	Submitted an annotated printout of the programming code.	5	
	Total:	**100**	

Sample Questions for Written Test

1. The difference between a robot and a machine is that a robot:
    a. Is controlled by a remote control device
    b. Is motorized to move
    c. Is programmed to do a specific function
    d. Is programmed to respond to its environment through various sensors

2. Robots are typically used in:
    a. manufacturing, space exploration, medical applications and the military
    b. agriculture, entertainment, and transportation
    c. all of the above
    d. none of the above

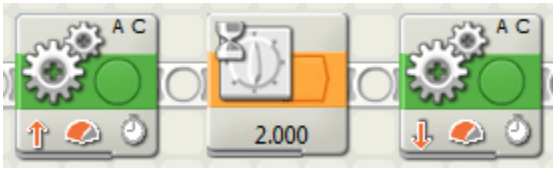
3. What are the components of a robot?
    a. Power source, microphone, digital input, speakers
    b. Computer processor, power source, wheels, motor
    c. Movable structure, sensors, computer processor, power source
    d. Sensors, computer processor, remote control, movable structure

4. What can an ultrasonic sensor do?
    a. Senses obstacles
    b. Measures distance
    c. Calculates ultrasonic light
    d. Detects objects and measures how close they are

5. What is an intelligent brick?
    a. It is slang for a person that is smarter than me
    b. It is the name of a new robot at Disney World
    c. It is the main component of a LEGOS Mindstorms NXT robot
    d. It is the microprocessor chip in a laptop computer

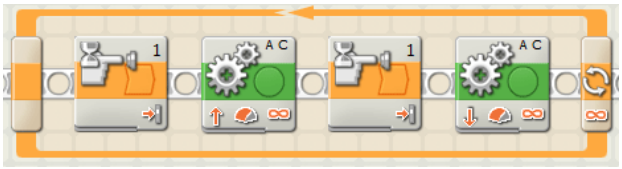
6. What is an advantage of using a flowchart in computer programming?
    a. There are no advantages because flowcharts are not used in computer programming
    b. Flowcharts can be used to help troubleshoot a problem
    c. Both a and b
    d. None of the above

7. The following programming code means:



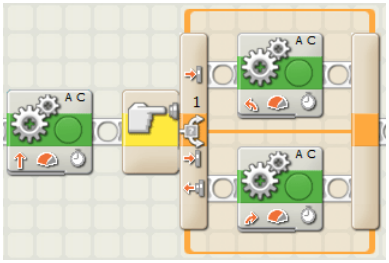
   a. Reverse, stop, move forward
   b. Wait, stop, move forward
   c. Forward, wait, reverse
   d. Forward, stop, reverse

8. The following programming code means:



   a. The touch sensor is being used to provide information to the brick
   b. The robot will rotate between moving forward and backward each time the touch sensor is pressed
   c. The loop block is used to repeat this program indefinitely
   d. All of the above

9. The following program code uses:



   a. Move block
   b. Touch block
   c. Switch block
   d. All of the above

10. Teamwork means:
   a. Working with others to achieve a goal
   b. Making sure that everyone's ideas are respected
   c. Each person makes contributions that are valuable to the team
   d. All of the above

Answer Key for Sample Questions

1. The difference between a robot and a machine is that a robot:
   a. Is controlled by a remote control device
   b. Is motorized to move
   c. Is programmed to do a specific function
   d. Is programmed to respond to its environment through various sensors

2. Robots are typically used in:
   a. manufacturing, space exploration, medical applications and the military
   b. agriculture, entertainment, and transportation
   c. all of the above
   d. none of the above

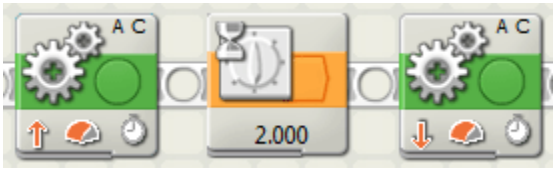
3. What are the components of a robot?
   a. Power source, microphone, digital input, speakers
   b. Computer processor, power source, wheels, motor
   c. Movable structure, sensors, computer processor, power source
   d. Sensors, computer processor, remote control, movable structure

4. What can an ultrasonic sensor do?
   a. Senses obstacles
   b. Measures distance
   c. Calculates ultrasonic light
   d. **Detects objects and measures how close they are**

5. What is an intelligent brick?
   a. It is slang for a person that is smarter than me
   b. It is the name of a new robot at Disney World
   c. It is the main component of a LEGOS Mindstorms NXT robot
   d. It is the microprocessor chip in a laptop computer

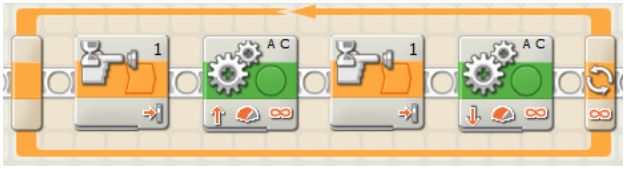
6. What is an advantage of using a flowchart in computer programming?
   a. There are no advantages because flowcharts are not used in computer programming
   b. Flowcharts can be used to help troubleshoot a problem
   c. Both a and b
   d. None of the above

7. The following programming code means:



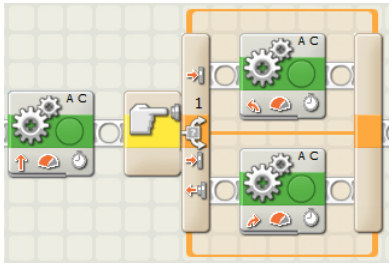
a. Reverse, stop, move forward
b. Wait, stop, move forward
c. Forward, wait, reverse
d. Forward, stop, reverse

8. The following programming code means:



a. The touch sensor is being used to provide information to the brick
b. The robot will rotate between moving forward and backward each time the touch sensor is pressed
c. The loop block is used to repeat this program indefinitely
d. All of the above

9. The following program code uses:



a. Move block
b. Touch block
c. Switch block
d. All of the above

10. Teamwork means:
a. Working with others to achieve a goal
b. Making sure that everyone's ideas are respected
c. Each person makes contributions that are valuable to the team
d. All of the above

2012 WISCONSIN 4-H ROBOTICS RALLY

PLANNING COMMITTEE

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Special thanks to…

Brown County | Kenosha County | Milwaukee County | Ozaukee County | Waukesha County