Introduction To Robotics

Unit Plan ~ Black Line Master




Effectively Using STEAM Education To Promote Project Based Learning In The 21st Century.

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First Edition: Published in June 2013 in Abbotsford, Canada.
Printed in Canada

GearBots Educational Resources is an advocate for STEAM Education:
Effectively using technology to promote project based learning in the 21st Century.

GearBots Educational Resources would like to thank the following organizations for their continued support:

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Unit Plan – Black Line Masters

The following lessons and instructional approach have been developed from our successful after-school programs. The unit plan provides educators with a clear instructional sequence needed to teach participants the core skills required to complete the GEARBOTS Training Challenge. GEARBOTS Educational Resources has developed double sided vinyl mats to complement and assist in the delivery of these lessons.

Items 1-8 should take approximately 10 sessions with the remaining classes working on the GEARBOTS Training Challenge using the CM001 Introductory Challenge Mat.

1. **Introduction to the unit (engineering process / iterative design)**
   - Build REM bots / kit orientation, computer orientation, and lab expectations (setup / cleanup procedures)

2. **Programming overview / orientation to the NXT-G**
   - Downloading firmware (if needed), programming environment, downloading a simple program, simple move blocks [straight and turn blocks using time]
     - Use TM001 Introductory Training Mat
     - Move Block Lesson (Tasks 1 to 9)
     - Summative Assessment: Square / Intersection Challenge

3. **Measured distance – converting distance (cm) into rotations or degree**
   - Introduction of Turning – Pivot [one wheel] and Point [two-wheel] turns
     - Use TM001 Introductory Training Mat
     - Use TM002 Grid Navigation / Maze Mat
     - Use VT005 Vortex / Buried Treasure Mat
     - Measured Distance Formula worksheet (Tasks A and B)
     - Navigational Protractor handout
     - Measured Distance and Degree Turns Lesson (Tasks 10 to 12)
     - Summative Assessment: Grid Navigation Challenge
     - Summative Assessment: Maze Challenge (Part A)
     - Summative Assessment: Vortex Challenge

4. **Wait for Touch (touch sensor)**
     - Use TM001 Introductory Training Mat
     - Wait for Blocks – Touch Sensor Lesson (Task 13)
     - Summative Assessment: VacuumBot Challenge

5. **Wait for Dark (light sensor)**
     - Use TM002 Grid Navigation / Maze Mat
     - Wait for Blocks – Light Sensor Lesson (Task 14 and 15)
     - Summative Assessment: Maze Challenge (Part B)

6. Loops and switches introduction / Following line

- Use the oval on TM001 Introductory Training Mat
- Use VT005 Vortex / Buried Treasure Mat
- Loops and Switches Lesson (Task 16)
- Review Challenge: 7 Block Review Program worksheet
- Summative Assessment: Line Following Challenge
- Summative Assessment: Buried Treasure Challenge

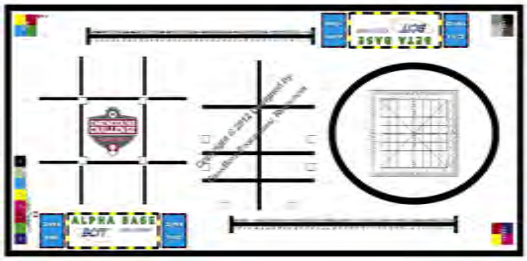
7. Wait for Near (ultra sonic sensor)

- Use TM002 Grid Navigation / Maze Mat (NOTE: must make light weight walls for the maze)
- Wait for Blocks – Ultra Sonic Sensor Lesson (Task 17)
- Summative Assessment: Walled Maze Challenge

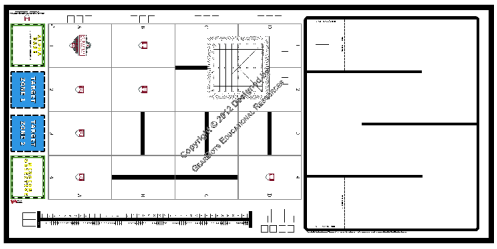
8. Training challenge – putting it all together

- Use CM001 Introductory Challenge Mat
- Application of skills: engineering process, working in teams, solving problems, creative thinking handouts
- Includes Mission Overview Handout, Engineering Logbook, Planning / Pseudo Code Booklet

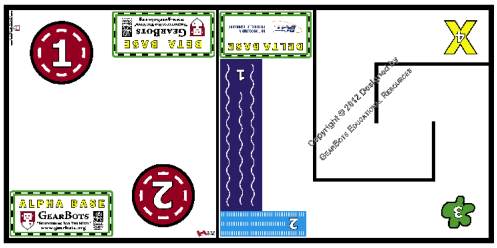
TM001 Introductory Training Mat



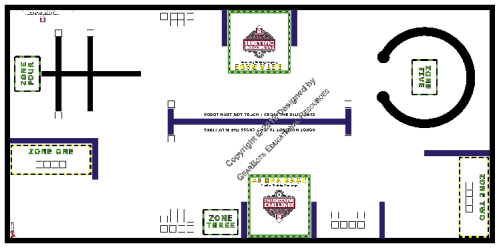
TM002 Grid Navigation / Maze Mat

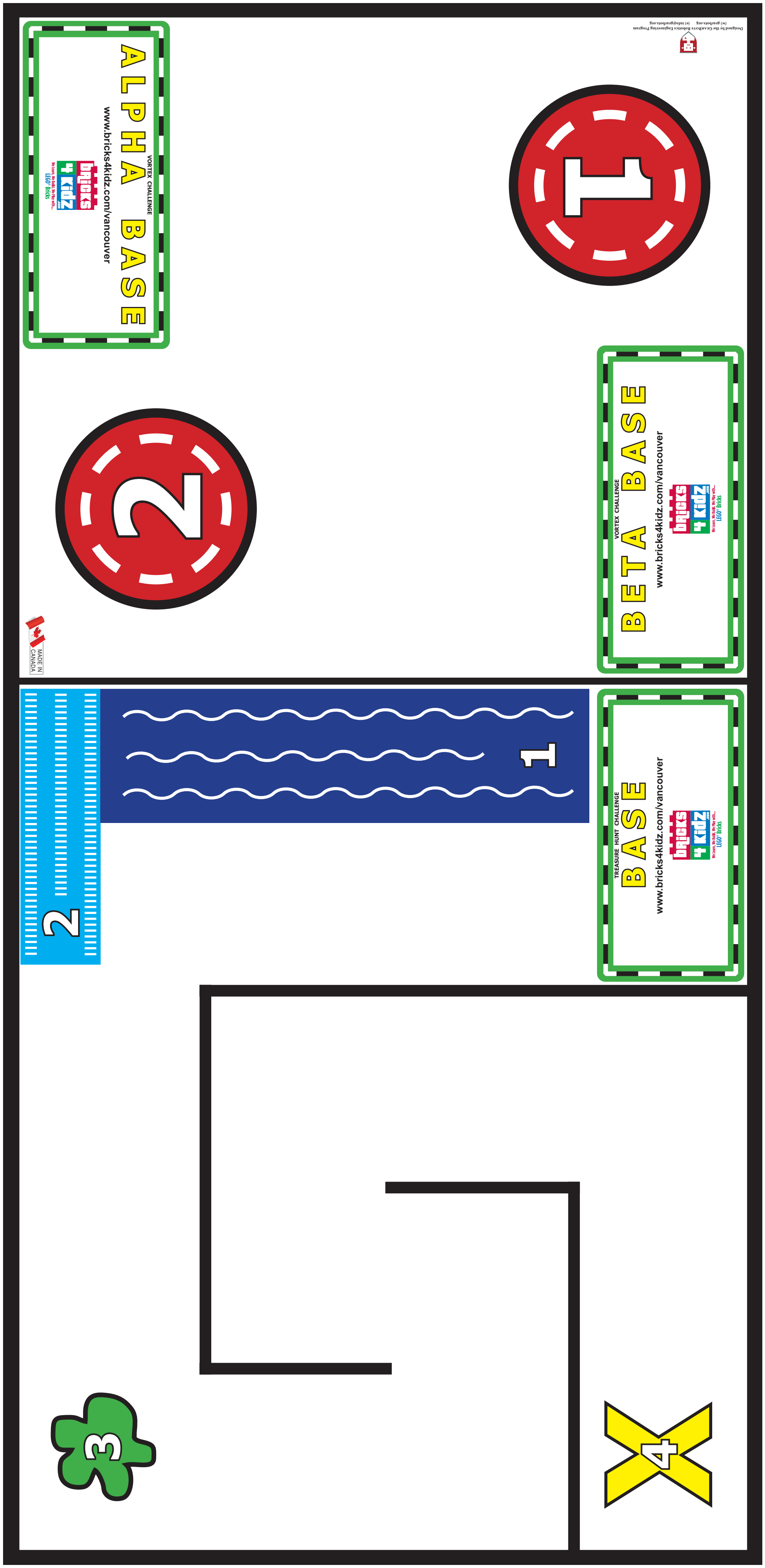


VT005 Vortex / Buried Treasure Mat



CM001 Introductory Challenge Mat





VORTEX CHALLENGE
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2
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BETA BASE
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TREASURE HUNT CHALLENGE
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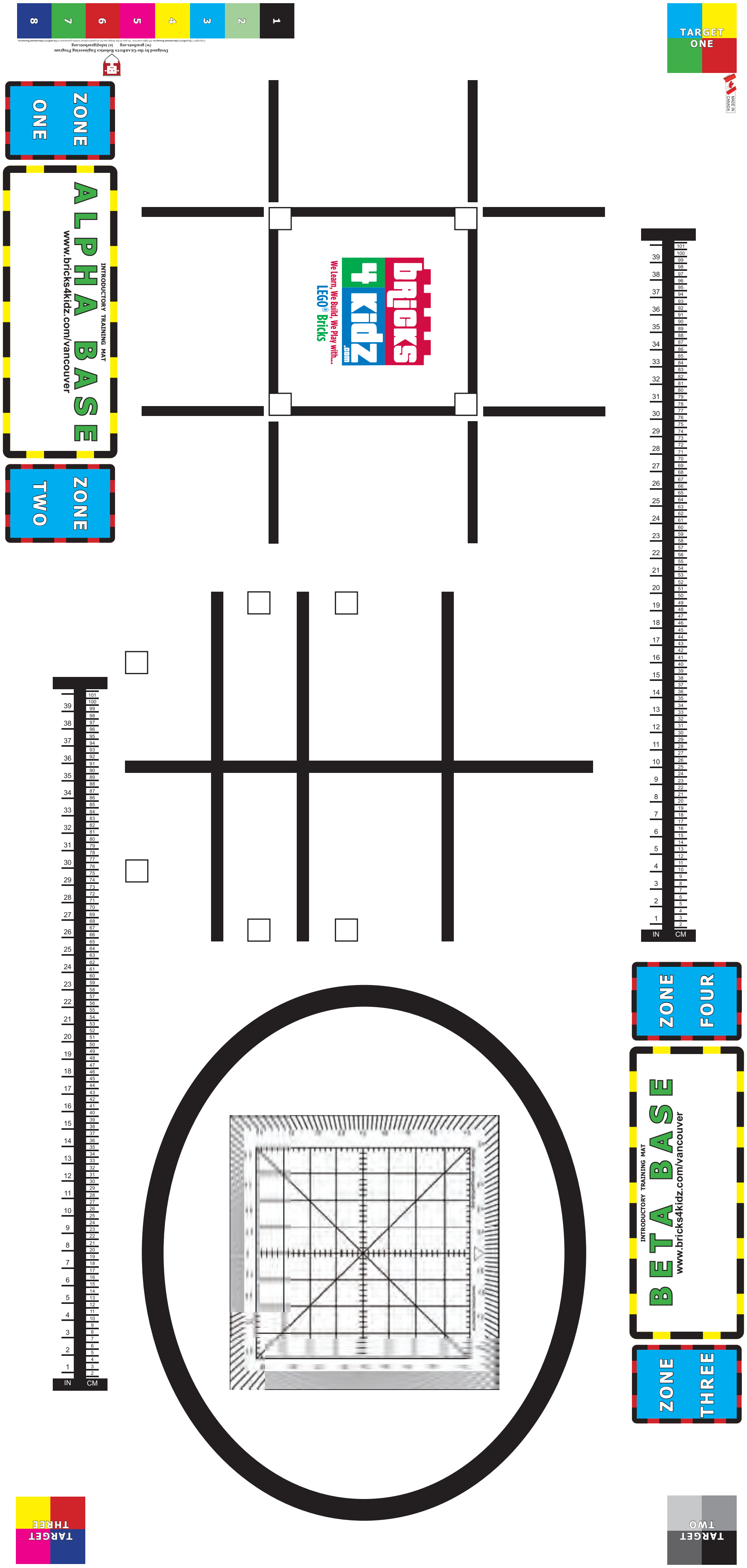
TARGET ONE
ZONE ONE
ALPHA BASE
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ZONE TWO
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ZONE THREE
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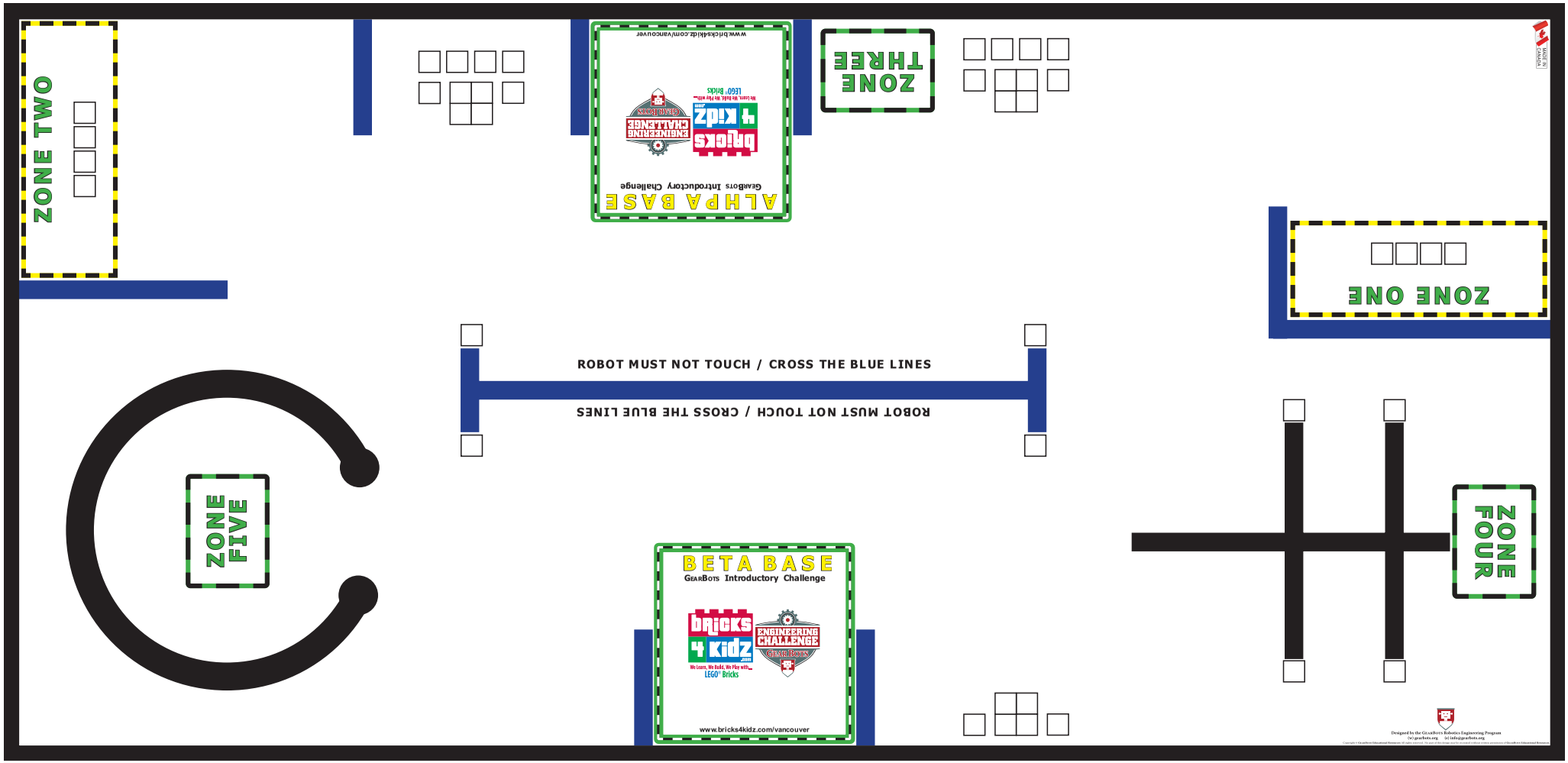
ZONE TWO
ALPHA BASE
GearBots Introductory Challenge
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ZONE THREE
ZONE ONE
ROBOT MUST NOT TOUCH / CROSS THE BLUE LINES
ROBOT MUST NOT TOUCH / CROSS THE BLUE LINES
ZONE FIVE
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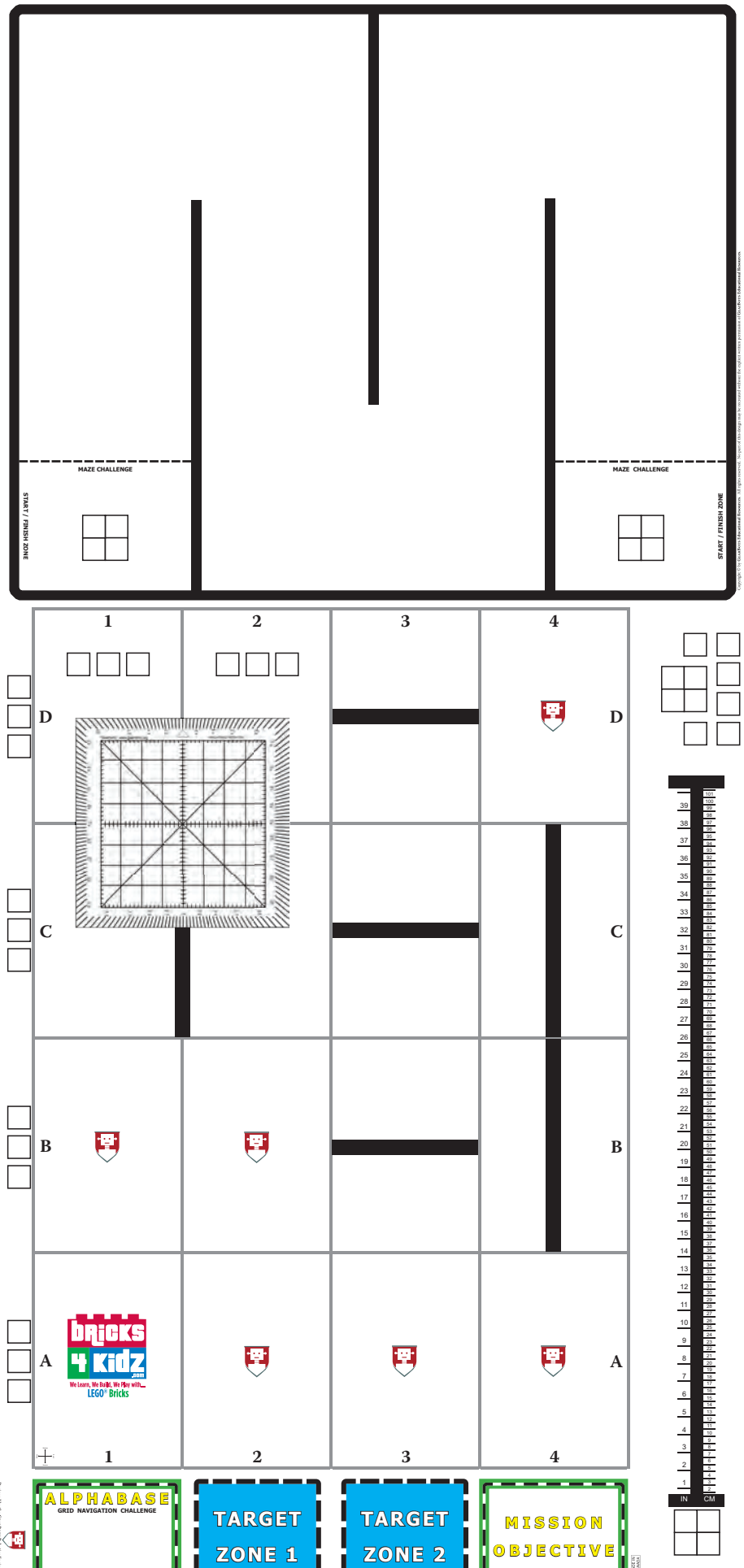
ZONE FOUR


MAZE CHALLENGE
START / FINISH ZONE
MAZE CHALLENGE
START / FINISH ZONE
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ALPHABASE
GRID NAVIGATION CHALLENGE
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TARGET ZONE 1
TARGET ZONE 2
MISSION OBJECTIVE

Name: _____ Date: _____

Introduction to NXT Robotics

GEARBOTS Educational Resources

Promoting Science, Technology, Engineering, Arts and Math (STEAM Education)

A. Introduction to Move Blocks: - Use TM001 Introductory Training Mat

First, you will need to build the basic REM TestBot. Simply put… if you want your robot to move, you will have to build and program your robot using the motors provided in your kit. Programming motors will allow you to move your robot in the following ways:

1. Move forward or backwards for a specific duration
2. Efficiently and effectively complete turns (any specified degree or angle, pivot turn, point turn)
3. Change the speed (power output) and distance traveled (modifiers) of your motors
4. Complete a square (using loops)

Key concepts taught in the lesson:

1. REM TestBot, common palette, program blocks, move blocks, pivot and point turns, duration, ports, iterative design, engineering method, programming - FLOW v1.0

1. Exercises: Complete each task before moving to the next one. Check-in at each step.

- Practice: Write, debug and test a simple 2-block program – each partner should program one block each.

- ☐ **TASK ONE:** Write, debug and test a program that allows your robot to travel forward for 2 seconds at 85% power and then coast to a stop. **Partner:** Change the amount of time.
- ☐ **TASK TWO:** Write, debug and test a program that allows your robot to travel forward for 3 rotations at 50% power and then backwards for 400 degrees at 60% power, spin around once and then stop. **Partner:** Change the speed (power level), direction, and the amount of time (fraction of a second - i.e. 1.5 seconds) and then stop.
- ☐ **TASK THREE:** Write, debug and test a program that allows your robot to travel forward for 4 rotations at 35% power, make an approximate 90^0 turn, travel forward for 2.5 seconds and then stop. **Partner:** Change the duration of the move block to 1.4 rotations and make an approximate 180^0 turn.
- ☐ **TASK FOUR:** Write, debug and test a program that allows your robot to travel an unlimited amount of time forward.
  Questions: What did you observe? Did the program work?

2. Introduction to Loops: - Question: When to use them and when not to use them?

- ☐ **TASK FIVE:** Write, debug and test a program that loops a 4-block program five times. **Partner:** Change the block order to change the robot's behaviour.
- ☐ **TASK SIX:** Write, debug and test a program that loops a 2-block program two times then goes forward at 50% for 2.4 rotations. **Partner:** Change the duration and power of the move blocks in the loop to change the robot's behaviour.

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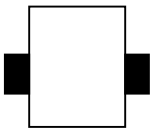
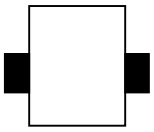
3. Introduction to Turning (Pivot and Points Turns):

1. **Pivot = One wheel turns:**
   [example: only port B or C moves]
   - Diagram the movement – draw arrows to indicate which way the motors will move



2. **Point = Two wheel turns:**
   [example: move slide bar all the way to the C motor or B motor]
   - Diagram the movement – draw arrows to indicate which way the motors will move
   Question: Which direction does the robot steer when you move the slide bar all the way to the B motor?



☐ **TASK SEVEN:** Write, debug and test a program that that allows your robot to complete a one wheel turn (pivot turn) to the right for 2 rotations at 40% power. **Partner:** Change rotations and power to change the robot's behaviour.

☐ **TASK EIGHT:** Write, debug and test a program that allows your robot to complete a two wheel turn (point turn) to the left for 3 seconds at 83% power. **Partner:** Change amount of time and power to change the robot's behaviour.

☐ **TASK NINE:** Write, debug and test a program that allows your robot to travel at 50% power for 2.9 rotations forward, complete a right pivot turn for 1 second, travel backwards for 180 degrees, complete a two wheel turn (point turn) to the left for 1.5 rotations, and forward at 25% power for 1 rotation. **Partner:** Change the turning blocks in the task to change the robot's behaviour.

DISCUSSION QUESTION:

- Think about the characteristics/behaviours of both turns. Why and when would you use a point turn over a pivot turn?

4. ENGINEERING TEAM CHALLENGE: Use as a Summative Assessment

- Introduction to "Iterative Design" and the "Engineering Process" in the Engineering Methodology Booklet.
  - Now it is time to put your engineering skills and talents all together. Complete the assigned challenges below. Once done, make sure to show your teacher.

☐ **Square / Intersection Challenge:** - Use Introductory Training Mat – TM001
Write, debug and test a program that completes the assigned challenge on the GEARBOTS Training Mat. Alternate between pivot and point turns.
Partners: Each partner should take turns programming the solution to this challenge.

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Square / Intersections Challenge

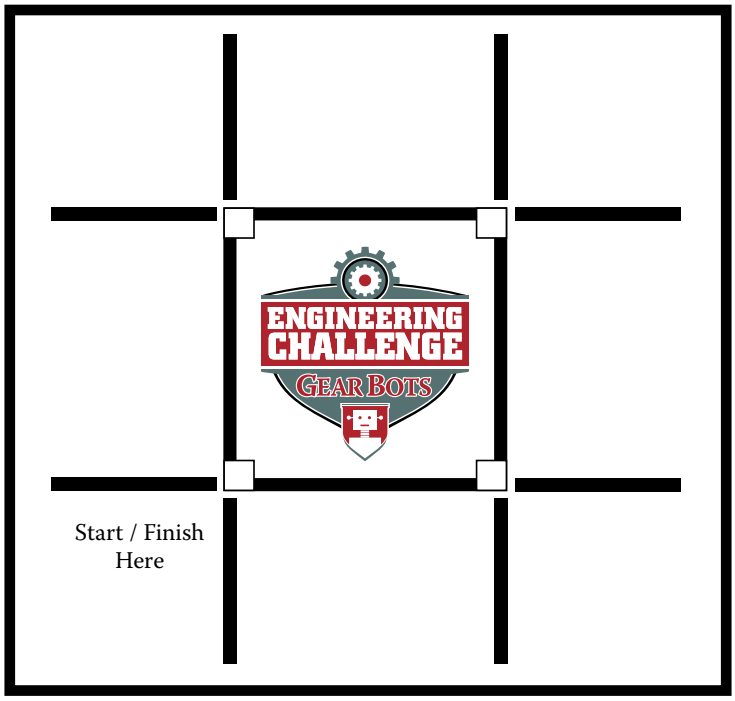
Use with the Introductory Training Mat - TM001

The objective of this introductory challenge is for your robot to move around the square without touching the square itself. Your robot should travel as close to the square as possible but remember no touching. If it does, you have to start over. You must complete the challenge without using the loops program feature. Beat the challenge by completing the task in less than 8 attempts.

Programming Review: Move blocks, measured distance, degree turns

Rules and Procedures:

1. Start your robot in the designated area
2. Program your robot to move around the square
3. Make approximately 90 degree turns at each corner
    - Alternate between pivot [one wheel] and point [two wheel] turns
4. Return to your original starting position



NOTE: DIAGRAM NOT TO SCALE

1. **Place robot in the start area**
2. **Drive forward and turn**
3. **Avoid touching the square**
4. **Return to the starting area**

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