FIRST® LEGO® League

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The Project

Independent. Engaged. Connected.

PREVIEW THE PROJECT

Through the Senior Solutions℠ Project, your team will:

- Find a senior partner
- Identify and learn about a problem faced by seniors
- Create an innovative solution to the problem you identify
- Share your problem and solution with others

THINK ABOUT IT

From the second you were born to this very minute, you are getting older. At first, this means growing bigger, learning to walk and talk, and discovering your connection to the people and the world around you. You grow from baby to toddler to child to teenager to adult to senior. Your Project challenge this season is to investigate the stage of growth known as being a senior.

Have you ever thought about what it's like to be 60 years old or older? "Boring!" you say? Consider these seniors:

- "Banana" George Blair entered his first barefoot waterskiing competition when he was 64. Since then, he set many world records—like being the first person to waterski barefoot on all seven continents. He was still waterskiing at age 93.
- At age 100 years, inventor Eemeli Väyrynen became the oldest person ever to receive a patent in Finland for his improved potato planter.
- People call Eileen Philippa "Phil" Raschker the greatest female athlete in the world over the age of 60. Some say she might be the greatest female athlete of all time.
- Annie Elizabeth "Bessie" Delany (age 101) and her sister Sarah Louise "Sadie" Delany (age 103) published a book about their first 100 years and were on the New York Times bestseller lists for 105 weeks.

But, just as there are challenges as young people grow from a baby to an adult, growing as a senior can have its drawbacks. Some people have trouble remembering things. As the nervous system grows older, it takes longer to notice changes and react. As muscles grow older, they can become less flexible. Some people move more slowly.

Body parts begin to wear out. Diseases like osteoporosis (bone loss), arthritis (swollen joints), glaucoma (pressure inside the eye that may cause blindness), and others often attack seniors. As friends and family members become less active, or even die, many seniors find themselves in smaller social groups. As seniors themselves experience aging, many require more care—physically, mentally, emotionally, and socially.

www.usfirst.org • www.firstlegoleague.org • FLL is the result of an exciting alliance between *FIRST* and the LEGO Group.

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Each person ages in a different way. Some people experience only one or two problems. Others seem to experience none at all. Lots of seniors still work, exercise, go dancing, travel, and have a great time. Just like anyone, seniors need the right solutions for their specific challenges.

FIND A SENIOR PARTNER

Your Project challenge this season is to solve a problem faced by seniors as they age. To start, your team needs to find a senior partner. Many people define seniors in different ways. For the Senior Solutions Project, look for an adult who is 60 years of age or older.

Not sure how to find a senior partner? Consider these suggestions:

Each Team Member — Begin by looking at your own family and friends. Consider grandparents, great grandparents, neighbors, assisted living residents, business owners, or babysitters. Make a list of the seniors you know. How do you know each one?

- Do you volunteer with seniors?
- Is there a senior center in your community?
- Are there activities, classes, or social events for seniors in your neighborhood?

As a Team — Next, take a look at each team member's list. Talk about how your team can connect with these people. Do they live near you? Can you talk with them in person? Over the phone? Using email or social media? By letter? Can you learn about what life was like when they were children? Teenagers? Young adults?

As a Team — Choose a senior and invite that senior to be your partner and help with your Project. Remember, not everyone who is asked will be able to help your team. If a senior says, "I'm sorry. I can't help," invite someone else. Your team may also choose to research a famous senior.

IDENTIFY A PROBLEM

As a Team — Get to know your team's senior partner. Find out about his or her life, history, and the challenges seniors face today. You might want to ask your senior partner questions like: When were you born? How was life different then? Where did you go to school? What did you study? What do you (or did you) do for a living? What did you like to do when you were 10 years old, 25, 40, last year? Are any of those things more difficult now? Why? What would make your life easier today?

Keep in mind that everyone wants to be treated with respect—and seniors are no exception. Find out what your senior partner loves about being older, as well as what things might be a little harder now. Your senior partner might tell you about challenges faced by a senior friend or relative. Here are a few examples of tasks some seniors say they find challenging:

- Recovering from injuries
- Keeping up with new technology
- Remembering certain things (the date, when to take a particular medicine, or to turn off the stove after cooking)
- Staying fit
- Finding fun things to do, by themselves and with others
- Managing their finances
- Getting what they need—food, household goods, medicine, clothing
- Communicating with family, friends, doctors, and other helpers

As a Team — Choose one problem that your senior partner identified and learn about it. (If your team chose to research a famous senior, choose one of the problems that senior experienced after age 60.) What causes the problem? What is being done to solve the problem today? Are new solutions being developed by scientists or engineers? Some resources you may use to look for information are: reports, books, magazines, and websites. Check with professionals who work in and around your community. Use any research tools you have available. Be prepared to share your information sources.

While you are researching your senior's challenges, find out about a professional who is working to solve their problem. Is a scientist, physician, or engineer helping with research or developing new technology? Is a social worker, community activist, or health care worker developing new programs? Can your team connect with a professional to learn more?

CREATE AN INNOVATIVE SOLUTION

Now that your team has decided on a problem, your challenge is to create an innovative solution—one that makes life better by improving something that already exists, using something that exists in a new way, or inventing something totally new. Learning about current solutions is just the beginning. How can your solution help seniors feel respected and do the things they love? How will your solution help seniors stay independent, engaged, and connected?

Think about it. Work together! Brainstorm! Share all your ideas. One team member's "crazy idea" just might inspire the perfect innovative solution. What could be done in a new way? What could be done better? What will it take to make your team's solution happen? A great solution might take all the imagination and ingenuity your team can muster. It might seem so obvious that you wonder why the problem even exists.

And remember, the most important thing is to have fun.

SHARE WITH OTHERS

Now, tell others about the problem you researched and exactly how your solution can help. You choose how to share what you've learned. Give a talk. Create a website. Perform a skit. Make a comic book. Rap. Create a poster. Pass out flyers. Write a poem, song, or story.

Think about who is helped by your solution. How can you let them know? Can you present your research and solution to other seniors, lawmakers, doctors, engineers, or groups who already help with your problem? Who would your senior partner like to tell about your solution? What's the best way to teach your audience about the problem and solution? Your sharing can be simple or elaborate, serious or designed to make people laugh while they learn.

PRESENT YOUR SOLUTION AT A TOURNAMENT

If your team chooses to attend a tournament, prepare a presentation to share your problem and solution with the judges. Your presentation can include posters, slide shows, models, multimedia clips, your research materials – be creative. Remember, you want to leave a lasting impression.

To be eligible for Project Awards and advancement your team must:

1. Identify your team's senior partner. (Your senior partner is not required to attend.)
2. Identify the problem your team chose to research.
3. Describe your team's innovative solution.
4. Describe how your team shared your findings with others.
5. Meet the presentation requirements:
   - Give your presentation live; you may use media equipment (if available) but only to enhance the live presentation.
   - Set up and complete your presentation in 5 minutes or less with no adult help.
   - Include all team members in some way during the Project judging session.

Learn how your presentation will be judged by reviewing the Rubrics located at: http://www.firstlegoleague.org/event/judging. Among other things, judges expect to your team to:

- Clearly explain both the problem and your team's solution
- Use different types of research resources, including professionals in the field
- Consider existing theories and solutions as you develop your own solution
- Be innovative
- Show that you thought about what it will take to make your solution happen in the real world
- Target your sharing toward those who might benefit from your team's work
- Find a way to present your work that is both effective and creative

MORE RESOURCES

Remember that the official FLL Challenge documents are always the final authority on what to do for this year's Project and Robot Game. If you are not sure how to start working, *FIRST*® LEGO® League provides resources to help:

- Check the Project FAQ often: http://www.firstlegoleague.org/challenge/projectfaq. Here FLL staff will clarify common Project questions.
- View the 2012 Project page at http://www.firstlegoleague.org/challenge/2012seniorsolutions. Download the Glossary, Resources, and Ask a Professional documents to help you start your research.
- The *FIRST* LEGO League Coaches' Handbook contains an introduction to FLL, the Challenge, tournaments, and judging. Find the first three chapters here: http://www.firstlegoleague.org/challenge/teamresources

If you have questions, email fllprojects@usfirst.org for Project support.

Robot Game — Field Setup

The field is where the Robot Game takes place.

- It consists of a field mat, on a table, with mission models arranged on top.
- The field mat and the LEGO® pieces for building the mission models are part of your Field Setup Kit.
- The instructions for building the mission models are on a CD, in the same box as the LEGO pieces.
- The instructions for how to build the table and how to arrange everything on it are in this document.

TABLE CONSTRUCTION

The Robot Game takes place on a specially designed table, so you'll need to build one to practice on if you don't already have access to one. With safety, weight, height, and cost in mind, a simple design is offered here, but as long as your surface is smooth, and your border walls are located properly, how you build the understructure is up to you. The construction is simple, but does require some wood-working skills.

At a tournament, two tables are placed back to back, but you only operate on one table, so you only need to build one table to practice on. However, since a tournament setup has a double wall at the interactive area where the two tables meet, practice tables need an extra wall of type B on the corresponding side. So here are the instructions for building one "half-table" including a double north wall:

Materials

Material	Quantity
Field Setup Kit (mission model LEGO elements, mat, CD, Dual Lock™)	1
sanded plywood (or other very smooth board) 96" X 48" X at least 3/8" (2438mm X 1219mm X 10mm)	1
two-by-three, 8' (2438mm) [actual cross-section = 1-1/2" X 2-1/2" (38mm X 64mm)]	6
flat black paint	1 pt. (1/2 L)
coarse drywall screws, 2-1/2" (64mm)	1/2 lb. (1/4 kg)
saw horses, about 24" (610mm) high and 36" (914mm) wide	2

Parts

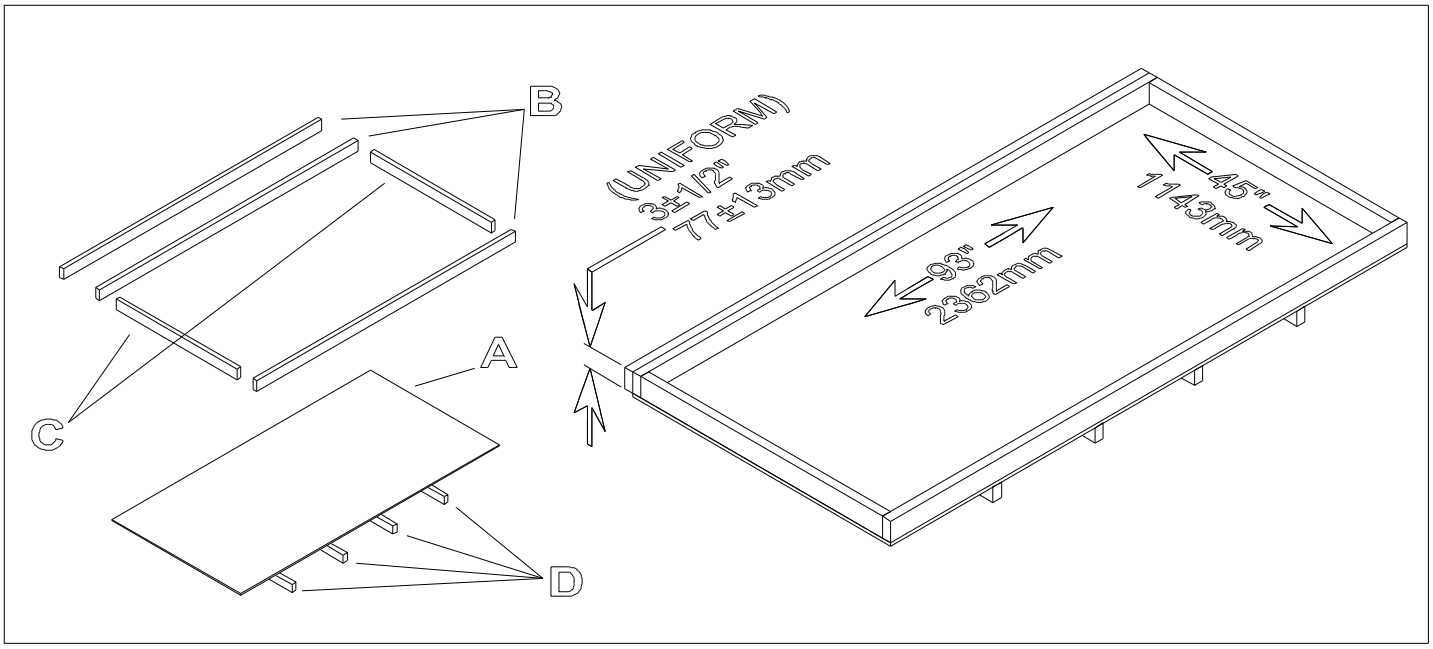
Part	Make From	Dimensions	Paint	Quantity
table surface (**A**)	plywood	96" X 48" (2438mm X 1219mm)	no	1
long border wall (**B**)	two-by-three	96" (2438mm)	yes	3
short border wall (**C**)	two-by-three	45" (1143mm)	yes	2
stiffener (**D**)	two-by-three	48" (1219mm)	no	4
saw horse	purchase	H ≈ 24" (610mm) W ≈ 36" (914mm)	no	2

Assembly

Step 1 - Determine which face of the plywood (**A**) is least smooth, and consider that the bottom face. On the bottom face, locate, clamp, and screw on the stiffeners (**D**) (about every 18 inches or 457mm). Be sure screw head tops are flush. Sand any splinters.

Step 2 - On the top face of the plywood, locate, clamp, and screw on the border walls (**B**,**C**) around the top perimeter. The wall-to-wall dimensions must measure 93±1/8" by 45±1/8" (2362±3mm by 1143±3mm), and the height of **B** and **C** must measure 3±1/2" (77±13mm), with all border walls being the same height as each other.

Step 3 - With the help of another person, place this table top on short saw horses (or milk crates, or anything else short and solid).



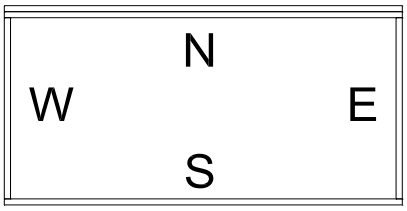
FIELD MAT PLACEMENT

Step 1 - Vacuum the table top. Even the tiniest particle under the mat can give the robot trouble. After vacuuming, run your hand over the surface and sand or file down any protruding imperfections you find. Then vacuum again.

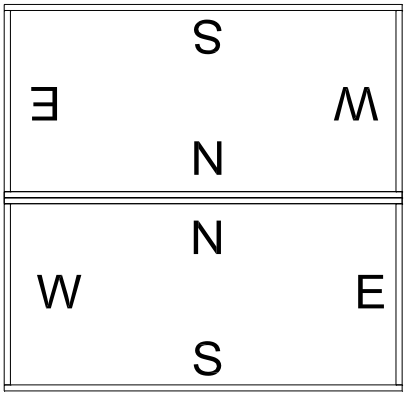
Step 2 - On the vacuumed surface (never unroll the mat in an area where it could pick up particles), unroll the mat so the image is up and its north edge is near the north/double border wall (note the location of the double wall in each table sketch below).

Step 3 - The mat is smaller than the playing surface by design. Slide and align it so that there is no gap between the south edge of the mat and the south border wall. Center the mat in the east-west direction (look for equal gaps at left and right).

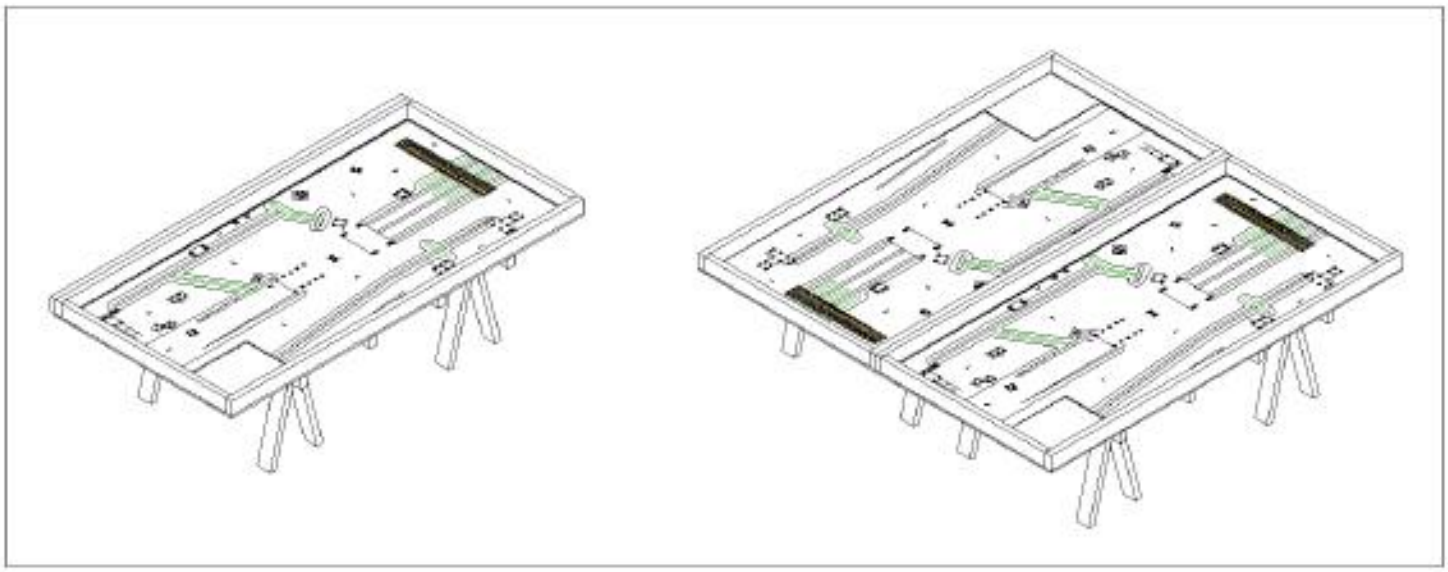
Step 4 - With help from others, pull the mat at opposite ends and massage out any waviness away from the center and re-check the requirement of Step 3. It is expected that some waviness will persist, but that should relax over time. Some teams use a hair dryer to speed the relaxation of the waviness.



PRACTICE ("HALF TABLE")



TOURNAMENT ("FULL TABLE")



MISSION MODEL CONSTRUCTION

Build the mission models - Use the LEGO elements and instruction CD from your Field Setup Kit. It will take a single person three to four hours to do this, so it's best done in a work party. For any team members with little or no experience building with LEGO elements, mission model construction is a great way to learn. This step is also a nice time for new team members to get acquainted with each other.

MISSION MODEL ARRANGEMENT AND SETUP

Dual Lock

Some models are secured to the mat, others are not. Where a model needs to be secured, the connection is made using the re-usable fastening material from 3M called Dual Lock, which comes in the flat clear bag with the LEGO elements in your Field Setup Kit. Dual Lock is designed to stick or "lock" to itself when two faces of it are pressed together, but you can unlock it too, for ease of transport and storage. The application process for the Dual Lock is only needed once. Later, the models can simply be locked onto the mat or unlocked. To apply Dual Lock:

Step 1 - Stick one square, adhesive side down, on each box you see on the mat with an "X" in it (Exception: Senior Solutions design changes after mat production allow for less Dual Lock than originally shown. Omit as described below.)
Step 2 - Press a second square on top of each of those, "Locking" them on, adhesive side up. TIP: Instead of using your finger, use a bit of the wax paper the squares came on.
Step 3 - Lower the model onto the squares.
CAUTION - Be sure to place each square precisely on its box, and each model precisely over its marks.
CAUTION - When pressing a model down, press down on its lowest solid structure instead of crushing the whole model. Pull on that same structure if later you need to separate the model from the mat.
TIP: For large and/or flexible models, apply only one or two sets at a time.

(**NOTE**: The rings in the pictures below are not part of setup and don't come in your kit – they're just in the pictures to help show areas of no Dual Lock.)

VIDEO SCREENS – For each screen, Dual Lock in 3 places as shown in the pictures. Set position is with the flag laid back and out as shown.

QUILTS – Dual Lock in 5 places for the blue pair and 6 places for the other pair, as shown on the mat.
GARDEN – Dual Lock in 2 places as shown in the picture. Omit the pair indicated by the ring. Orient with the brown crate over its mark on the mat. Number, shape and placement of the flowers on their base is non-critical and allowed/expected to vary. The crate's contents are also non-critical.
STOVE – Dual Lock in 4 places as shown on the mat. Set position is with the two red burners showing.
COOPERATION – Dual Lock in 4 places as shown on the mat. Set position is with the pointer leaning east.

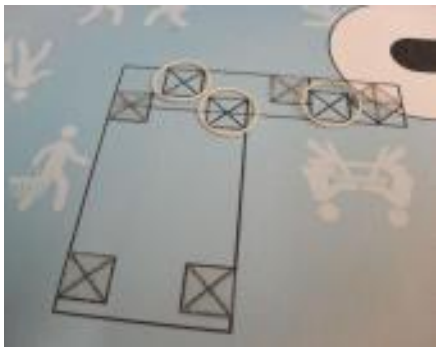
QUILTS

GARDEN

STOVE

COOPERATION

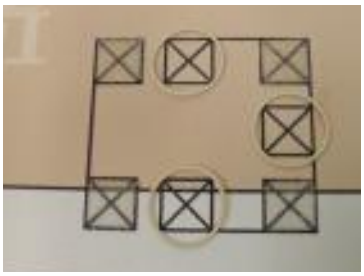
DOG – Dual Lock in 5 places as shown in the picture. Omit the pairs indicated by the white rings. Set position is with the gray disc pulled all the way east, and with the skateboard accurately placed between its location lines, in contact with the south ram. Activate and reset by pushing/pulling on the gray disc only. Don't try to push the south ram north.



CARDIO MACHINE – Dual Lock in 4 places as shown in the picture. Omit the pairs indicated by the rings. Set position is with a RED pinwheel arm UP AND the pointer exactly aligned with the 3rd green light

WEIGHT MACHINE – Dual Lock in 8 places as shown in the picture. Omit the pairs indicated by the rings. Set position is with the wheel hanging directly down, and with the ratchet/catch lever resting on the east side as shown.

SHELVES – Dual Lock in 4 places as shown in the picture. Omit the pairs indicated by the rings. Setup position is with one loop accurately centered on each shelf. The lower loop is parallel with the white panels, the upper one is 90° from the panels. Loops must be vertical and not distorted.



CHAIR AND TABLE – Dual Lock in 4 places as shown on the mat. Setup position is with the chair aligned accurately with its mark and "broken" as shown. The south side of the small part swings west. Both black connecting pins are in the small part, but only the north pin is in the large part.

UNRELATED – Please ignore the model on the left if you see it. It doesn't come in your kit, shouldn't be on your field, and pretty much has nothing to do with anything. It is a patently useless model from 2011, whose breathtaking insanity is exceeded only by its off-the-wall aggression. Unfortunately, problems with this enormously irritating troublemaker have escalated severely over the last 9 months to the point where the even the authorities are afraid. Be careful not to confuse the unstable nuisance with the character on the right, known to be agreeable, intelligent and funny, though still profoundly inconsequential. Finally, please ignore this entire paragraph if it confuses you in any way.

COMBATIVE

OKAY

BOWLING PINS – Place on their marks accurately. Check for straightness (press lengthwise) with every reset.

MEDICINE BOTTLES – Place bottles accurately within their marks, but in random order of color, and at random locations along the length of the marks, except that they must be spaced at least one unit of their own width from each other. The white labels face south. Loops must be vertical and not distorted.

RANDOM

RANDOM

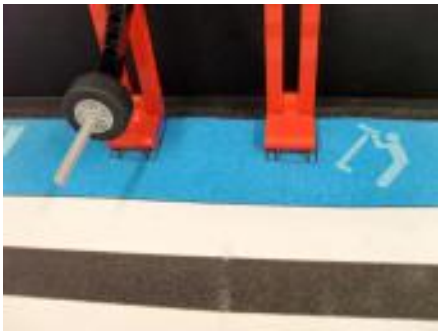
MINIMUM SPACING

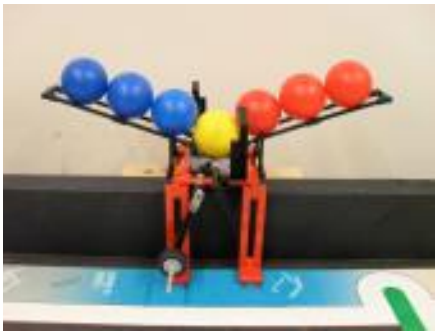
ACCURATE ALIGNMENT

BAD

BAD

BALL RACKS – At a tournament, this model is centered exactly and shared by two back-to-back fields. If you have only one field for practice (which is normal, and all you need), this model extends half off the north center of your field, so you need to place one or more boards as needed to support that side evenly. Dual Lock in 2 places as shown on the mat, and 2 more places as needed on the other side. Place balls as shown. The center ball must be yellow, and the other balls must be segregated by color – but it doesn't matter which side has which color.





TRANSITIONS – For the stairs, Dual Lock in 8 places as shown in the picture. Omit the pairs indicated by the rings. For the platform's anchor, and the ramp, Dual Lock in 2 places and 8 places respectively, as shown on the mat. Center the tipping platform so it's trapped over its anchor. The platform should align with the stairs and ramp, and tip north or south, but not slide anywhere.

BASE – Place the remaining 4 quilt squares, plants, and yellow ball in Base. It doesn't matter how they're placed there, since you're allowed to move things around in Base and other storage areas any time.

REFERENCE LEFT SIDE VIEW

REFERENCE RIGHT SIDE VIEW

FIELD MAINTENANCE

- **Border Walls** - Remove any obvious splinters, and cover any obvious holes.
- **Field Mat** - Make sure the mat touches the south border wall, and is centered east to west. Avoid cleaning the mat with anything that will leave a residue. Any residue, sticky or slippery, will affect the robot's performance compared to a new mat (many tournaments use new mats). Use a vacuum and/or damp cloth for dust and debris (above and below the mat). To get marks off, try a white-plastic pencil eraser. When moving the mat for transport and storage, be sure not to let it bend into a sharp kink point, which could affect the robot's movement. Tournaments using new mats should unroll the mats as far in advance of the tournament day as possible. For added control at the east or west edges of the mat, tape is allowed, with a maximum of ¼" (6 mm) overlap. Foam tape is not allowed.
- **Mission Models** - Keep the models in original condition by straightening and tightening solid connections often. Ensure that spinning axles spin freely by checking for end-to-end play and replacing any that are bent.

Robot Game — Missions

KEEP IN MIND: You LOVE a senior. You will BE a senior. The Senior Solutions℠ challenge is about concepts that affect everyone, directly and indirectly, both now and later.

Seniors need and want the same things they did when they were young – the same things YOU want. They want to be:

INDEPENDENT – to do what they want, when they want, the way they want (no matter where they live)
ENGAGED – to feel needed, and productive, and to have fun
CONNECTED – to have meaningful relationships with family and friends

Seniors have wisdom and perspective, from a full lifetime of experience. The problem is that the older we get, the more difficult life gets. We lose strength, speed, flexibility, and memory. Our hearing, eye sight, and other senses are diminished. It's harder to get around. Health problems creep in. Loved ones pass away. New technologies are unfamiliar to us…

In the Senior Solutions robot game, you and your robot will manage a mix of challenges and activities related to being independent, engaged, or connected. None of them really has to do with being "old," but a few of them have a harder version and an easier version. As you notice how much harder the hard versions are, and design your robot to master them, imagine what innovative technical designs and improvements you could make in real life that would make life easier for seniors – for your loved ones, and for your future self!

FRIENDLY WARNING: While it's obvious that everyone needs to become an expert on the details of the **Missions** below, it's also EXTREMELY IMPORTANT for everyone, vets as well as rookies, to read the OTHER THREE CRITICAL ROBOT GAME PAGES: **Field Setup** + **Rules** + **Updates** and go back to them repeatedly. Look at the benefits…

TEAMS WHO READ EVERYTHING
— have fewer questions
— have less rework
— have fewer surprises at tournaments
— score higher
— have more fun

TEAMS WHO DON'T
— operate in a fog
— start over and lose time
— learn a lot from… referees
— lose points
— get stressed

WOOD WORKING

Basic Description: Robot gets the chair to Base. You fix the chair by hand. Robot brings the chair to the table.

PRECISE SCORING CONDITIONS:

— Chair is fixed and in Base: 15
— OR —
— Chair is fixed and any part of it is in the space under the table: 25

Example - NO SCORE

Example - SCORE

MEDICINE

Basic Description: The bottles are arranged randomly before the start of each match (See Field Setup). Robot gets the green medicine bottle to Base without disturbing orange ones.

PRECISE SCORING CONDITIONS:

— Green bottle in Base and no orange bottles obviously moved or angled out of setup position: 25

SERVICE ANIMALS

Basic Description: Robot applies force to gray disc, causing dog with phone to move toward Base.

PRECISE SCORING CONDITIONS:

— Dog is in Base: 20

METHOD RESTRICTION:

— The dog's initial movement to Base must be caused by a push or impact to the gray disc.

BOWLING

Basic Description: Robot sends balls to knock pins down. If the pins are not all down after the first try using a yellow ball, the referee returns that ball to Base for a second try (this can only happen once per match).

PRECISE SCORING CONDITIONS:

— 1 to 5 pins down: 7 EACH

— OR —

— 6 pins down: 60

METHOD RESTRICTION:

— Each pin's fall must be caused by impact from a completely loose and independent ball (not touching or guided by anything at the time of impact) or another loose/independent pin. Pins falling for any other reason are worth 0.

STRENGTH EXERCISE

Basic Description: Robot lifts the west bar to make the weight rise.

PRECISE SCORING CONDITIONS:

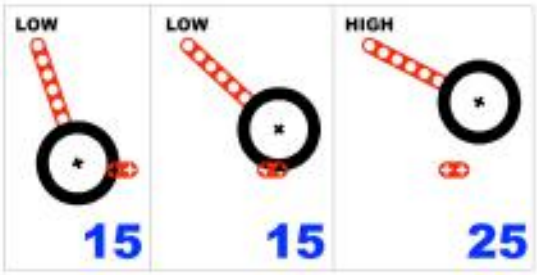
— Weight height equal to or between the ones labeled LOW: 15

— OR —

— Heights equal to or higher than the one labeled HIGH: 25

METHOD RESTRICTION:

— The weight must rise due to the west bar being lifted.



STOVE

Basic Description: Robot gets all burners to show black.

PRECISE SCORING CONDITIONS:

— All 4 burners black: 25

GARDENING

Basic Description: Robot adds to the garden.

PRECISE SCORING CONDITIONS:

— Plant's base touching a white target area: 25

VIDEO CALL

Basic Description: Robot gets the flags to rise.

PRECISE SCORING CONDITIONS:

— Flags all the way up: 20 EACH

QUILTING

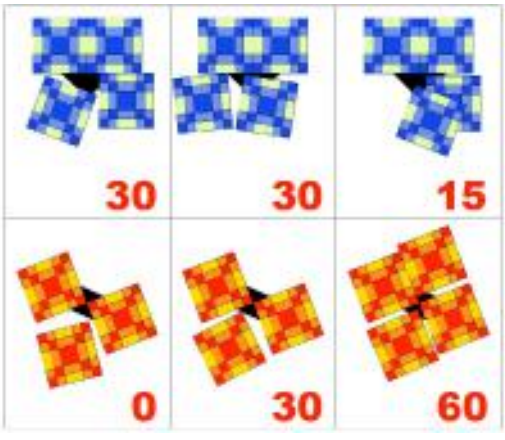
Basic Description: Robot adds squares to quilts.

PRECISE SCORING CONDITIONS:

— Blue quilt squares touching their black target regions: 15 EACH

— ALSO —

— Orange quilt squares touching their black target area: 30 EACH



CARDIOVASCULAR EXERCISE

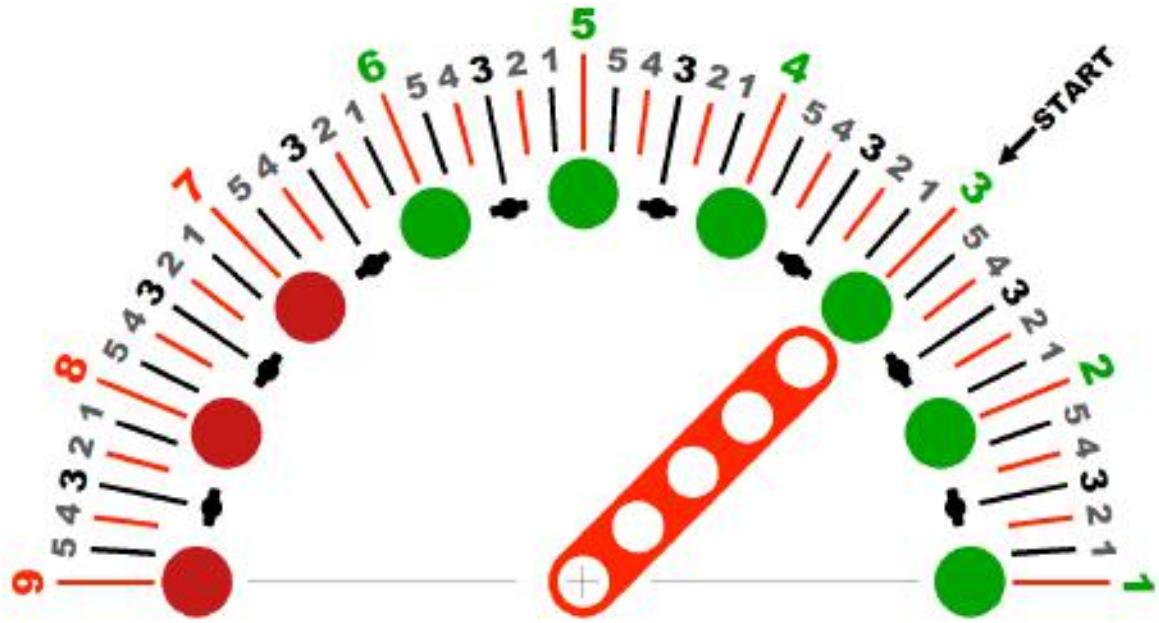
Basic Description: Robot turns the pinwheel 90° at a time.

PRECISE SCORING CONDITIONS:

— Points are shown in red on the chart.

METHOD RESTRICTION:

— Between every click of the wheel and the next, the robot must get completely into Base at least once.



POINTER POSITION	POINTS
9-0	118
8-5	117
8-4	116
8-3	115
8-2	114
8-1	113
8-0	112
7-5	111
7-4	110
7-3	109
7-2	108
7-1	107
7-0	106
6-5	103
6-4	100
6-3	97
6-2	94
6-1	91
6-0	78
5-5	75
5-4	72
5-3	69
5-2	66
5-1	63
5-0	60
4-5	55
4-4	50
4-3	45
4-2	40
4-1	35
4-0	30
3-5	25
3-4	20
3-3	15
3-2	10
3-1	5
3-0	0
2-5	-5
2-4	-10
2-3	-15
2-2	-20
2-1	-25
2-0	-30
1-5	-35
1-4	-40
1-3	-45
1-2	-50
1-1	-55
1-0	-60

FLEXIBILITY

Basic Description: Robot gets yellow loops to Base.

PRECISE SCORING CONDITIONS

Yellow loops in Base: 20 EACH

TRANSITIONS

Basic Description: Robot gets onto the center platform and is there when the match ends.

PRECISE SCORING CONDITIONS:

— Robot touching tilted center platform only: 45

— OR —

— Robot touching balanced center platform only: 65

For either case:

The center platform must not be touching anything but the mat and the robot.

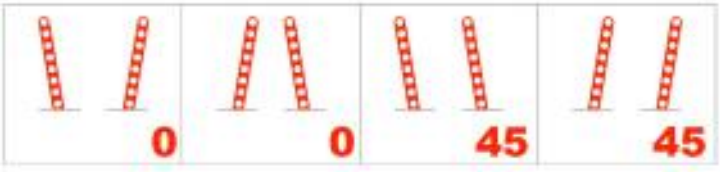
The center platform must remain between the stairs and the ramp.

SIMILARITY RECOGNITION AND COOPERATION

Basic Description: Robot aligns your pointer with the other team's pointer.

PRECISE SCORING CONDITIONS:

— Pointer on your field is parallel with pointer on other field (direction doesn't matter): 45



BALL GAME "FUTURE EFFECTS OF OUR CURRENT DECISIONS"

Basic Description: Both teams get points for the total number of balls on the racks at the end of the match, but only one team gets points when their color is at the center.

SCORING CONDITIONS

Balls on the racks (all balls, center + sides, any color, added together): 10 EACH FOR BOTH TEAMS

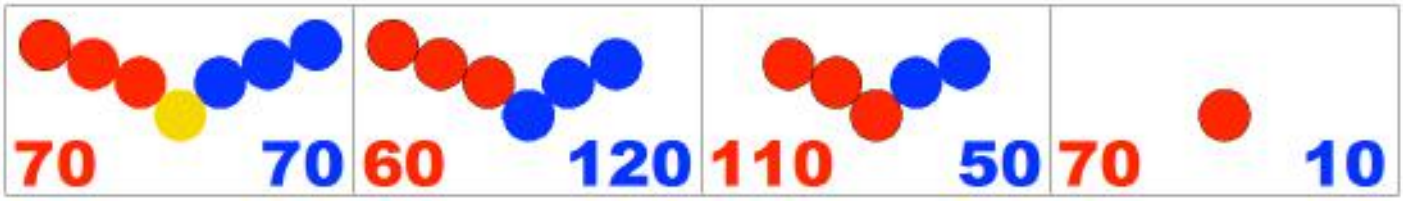
— ALSO —

Your color ball in the center position: 60 FOR YOUR TEAM ONLY

METHOD RESTRICTION:

— A push of the lever is the only allowable way for your robot to cause a ball of the other team's color to fall.

— Only one ball of the other team's color is allowed to fall for any push of the lever by your robot.



FACT: Referees note the current number of balls left at all times.

FACT: If the ball game model becomes jammed, broken, or drops any ball other than the center position, this will be known as a "glitch."

If a glitch is caused by either of these reasons:

- **your robot pushes the lever on your side eastward, but too fast, too far, or not far enough…**

— OR —

- **your robot interacts with the model in any other way than pushing the lever eastward the appropriate speed and distance…**

— Both teams get credit for whatever balls were left on the rack before this happened.

— The other team (only) gets credit for center position (60).

If the referee determines that a glitch has occurred due to the model's design, setup, or maintenance, both parts of the ball game mission are frozen and score as follows:

- **Both teams get credit for whatever balls were left on the rack before this happened.**
- **Both teams get credit for center position (60).**

TOUCH PENALTY – If you touch the robot while it's outside Base, the referee clicks the cardiovascular exercise dial one click toward zero.

Robot Game — Rules

(Including Philosophies, Definitions, and Procedures)

1 - GRACIOUS PROFESSIONALISM®

- You are "Gracious Professionals." You are competing hard against PROBLEMS, while treating PEOPLE with respect and kindness - people from your own team, as well people from other teams.
- You build onto other people's ideas instead of resisting or defeating them.

2 - PARTICIPATION

- The maximum allowable team size is ten (10) members, not including coaches and mentors.
- Allowable ages vary by region. Contact your operational partner for specifics if needed.
- At the tournament, only TWO team members at a time are allowed right up at the competition table except during repair emergencies.
- The rest of the team must stay back from the table, but close enough for different members to tag in or out as desired at any time. Exact positioning is decided by the tournament officials.

3 – INTERPRETATION

- Robot game text means exactly and only what it says, so it should be taken literally whenever possible.
- Do not interpret text based on your assumption about intent, or on how a situation might be in "real life."
  - Example: If a mission is to "enter the house," the window is just as valid an entry point as the door.
- If a detail isn't mentioned, then it doesn't matter.
  - Example: If a mission is to "put the cup on the table," upside down is just as valid as right side up.
  - Example: If a mission is to "put one object on the other," it doesn't matter which is on top.
- There are no hidden requirements or restrictions, but there are hidden freedoms, and you're encouraged to find them!

4 – EQUIPMENT

- EVERYTHING you use in the competition area directly or indirectly for strategy (mission-related goals) must be made entirely of LEGO-manufactured elements in original factory condition. Stickers are not allowed, except LEGO stickers, applied per LEGO instructions. Paint, tape, glue, oil, zip-ties, etc. are not allowed.
  - Exception 1: You may reference a paper list to keep track of robot programs.
  - Exception 2: LEGO string and tubing may be cut to length.
  - Exception 3: Marker may be used only in hidden areas, for ownership identification.
  - Exception 4: Carts, trays, and boxes may be used for hand-transport and storage, off the table only.

- REGULAR ELEMENTS - You may use as many non-electric LEGO elements as you like, including pneumatics, rubber bands, and string, and they may be from any source or set (MINDSTORMS®/TECHNIC/DUPLO®/ BIONICLE™/STAR WARS™/HARRY POTTER™/etc.). Exception: Factory-made wind-up/pull-back "motors" are not allowed.

- CONTROLLERS - You are allowed a maximum of one controller in the competition area in any one match. Choose one of the two LEGO-manufactured types shown here. No other controller is allowed.

- SENSORS - You are allowed as many sensors as you like, but the types are limited as follows:
  - o They may only be touch, light, color, rotation, or ultrasonic.
  - o They must be LEGO-manufactured MINDSTORMS type as shown here.

  WARNING 1: The fact that a sensor was/is being sold by an official LEGO shopping source does not mean that sensor was made by LEGO.

  WARNING 2: The presence of the LEGO logo on a sensor does NOT mean it was made by LEGO.
  - o Be SURE any sensor you buy or use looks exactly like one pictured here.

- MOTORS - You are allowed a maximum of three MINDSTORMS motors in the competition area. Choose your favorite combination from among the two LEGO-manufactured types shown here. No other motors are allowed.

- Quantity limits don't just apply to what's on your robot "right now." The referee (the "ref") adds up everything you have with you in your boxes, your hands, your trays, and on the table. All of it counts towards your total.
  - o Example: If you have multiple motorized attachments, but it takes two motors to drive the robot, you must find a way to switch that third/last legal motor from one attachment to the next.
  - o A fourth motor in the competition area is not allowed, no matter what.
  - o Even if you plan to run only three motors at a time, a fourth motor is not allowed.
  - o Even as a spare, a weight, or a decoration, a fourth motor is not allowed.
- You may not use more than one robot in any one match, but it's okay to use a different robot in a different match.
- LEGO wires and converter cables are allowed as needed.
- No other electric elements nor devices are allowed for use in any way in the competition area.
- Spare electrical parts are allowed in the PIT area.
- Objects functioning as remote controls are not allowed anywhere, any time.

- NON-ROBOT EQUIPMENT - Your equipment may include LEGO elements or devices other than the robot and its attachments.
  - o Example 1: You may use a frame/"jig" to help aim your robot in Base.
  - o Example 2: The robot may carry a ramp out to help itself cross a barrier.

  If outside Base, such "strategic objects" are left wherever the robot leaves them.

- SOFTWARE - The robot may only be programmed using LEGO MINDSTORMS, RoboLab, or NXT-G software (any release). No other software is allowed. Patches, add-ons, and new versions of the allowable software from the manufacturers (LEGO and National Instruments) are allowed, but tool kits, including the LabVIEW tool kit, are not allowed.

- VIOLATION - If the robot is in violation of the equipment rule and cannot be corrected, the decision about exactly what to do rests with the tournament officials, but it is possible the team may not be eligible for awards.

5 – MISSION

- A mission is one or more achievable objectives/results worth points, as detailed on the "**Missions**" page.
- You decide the order in which to try the missions, and how many to try with each program on the robot.
- You don't have to try every mission.
- You may re-try missions when that's possible, but the field is not reset for that purpose. Example: If a mission is for the robot to topple a stack eastward, and the robot doesn't reach it, you could try again later, since the stack is undisturbed. But if the active robot topples the stack westward, the mission is impossible to re-try, and does not get reset.

6 – MATCH

- At a tournament, two robot game fields are joined back to back, and you are paired opposite another team to compete in a match. There are at least three matches. Each match lasts 2-1/2 minutes. Here's the process:
- You get to the competition table and have at least one minute to prepare your equipment.
- The match starts and you start the robot from Base. Once started, the robot is "active" and is understood to be working "autonomously" on missions, under its own power and programming, allowed to grow to any size and go anywhere.
- The robot might get a lot done, or a little, but eventually you are likely to need/want to handle it. For example, it might get stuck, or you might want to add an attachment or unload some cargo.
- If you do decide to touch the robot while it's active, no matter where it is or what it's doing, that makes it "inactive," and it must immediately be carried to Base if it's not already there.
- While the inactive robot is in Base, you prepare it for its next active period, and restart it.
- These steps repeat (often with music, an announcer, and cheering in the background!) until the match end signal sounds. The timer never pauses during a match.
- You play at least three matches a tournament, each one being a fresh chance for you to get your best score.
- No match has anything to do with another, and only your best score counts specifically toward the Robot Performance Award except when breaking ties. "Playoffs" if held, are just for added fun.
- If it is known in advance that you will not have another team opposite you, a volunteer or "house" team substitutes. If not, and you compete against an empty table, you get the points for any missions you tried but could not complete because the other team was missing.
- After the match, no one is allowed to touch anything on the field until the ref has recorded the condition of the field and come to agreement with you (kids only) about what points were scored or missed and why.
- Data is marked on a sheet which you initial, making the sheet final.

7 – ROUND

- The process of cycling all teams through one match each is called a round.

8 – BASE

- Base is an imaginary box formed by vertical walls that rise from the perimeter of the Base area, including the inside surface of the border walls, and by an invisible ceiling 16" (406mm) high.
- This means Base is not just an area on the mat – it's a VOLUME.
- Usually there is a gap between the mat and a side border wall… Base includes this gap.
- Anything even barely in Base counts as being in Base unless the robot moves it completely out.
- Anything in the team's possession is understood to count as being in Base, and is okay to store or handle.

9 – FIELD

- The field is where the robot game takes place. It consists of mission models on a field mat on a table.
- The field mat and the LEGO elements for building the mission models are part of your Field Setup Kit.
- The instructions for building the mission models are on a CD which comes in the same box as the LEGO elements and mat.
- All details about how to set up the mission models after they've been built are on the **Field Setup** page.

10 - MISSION MODELS

- Mission models are the objects that are already on the field when you walk up to it.
- You may not bring duplicate mission models to the table if they could confuse scoring.
- You may not take mission models apart, even temporarily.
- You may not add to nor trap mission models by hand as to cause a failure of the "gravity test."

11 - GRAVITY TEST

- Any time you (by HAND) make an individual mission model touch, trap, or be trapped by ANY other object (including the robot, other team-supplied items, and other models) - Gravity alone should be able to separate them if the heavier were picked up and/or turned over.
- In the case of identical models, it doesn't matter which is picked up.
- The team performs this "gravity test," only if asked by the ref, and only when failure looks probable.
- The ref does not allow a start unless all mission models in Base could pass the gravity test.
- Only if there is no hand-help at all, the ROBOT is allowed to cause models to fail the gravity test.

12 – ROBOT

- The robot is the controller and anything joined with it by hand (any method, any configuration) which is designed not to separate from it except by hand.

13 – CARGO

- Cargo is anything the robot has with it for transport or release.

14 - AUTONOMY - The robot game is played by an "autonomous" robot.

- That means the robot must do its work without any influence/help from you while it's working. You PREPARE the robot, but it PERFORMS on its own.
- The robot is allowed to perform in or out of Base, but preparation must take place in Base.

15 - ACTIVE ROBOT <> INACTIVE ROBOT

- The moment the robot is started, it becomes "ACTIVE," and remains so until the next time you touch/influence it.
- At the moment of that touch, the robot becomes "INACTIVE," and is hand-prepared for restart from Base.

16 – HANDLING

- **Calibration** – During your pre-match setup time only, you may calibrate light & color sensors outside Base.
- **Quality Control** – During your pre-match setup time only, you may ask the ref to double-check that a particular setup is correct/within spec, but you may not request any custom setup, in or out of the specified setup range.
- **Strategic Hand-Action** – Your hands may not directly or indirectly strategically place, extend, roll, topple, drop, throw, eject, slide, shoot, or otherwise send things outside Base. Your hands may not directly or indirectly strategically change the position, motion, quantity, or other status of things outside Base. Only the robot may make strategic changes outside Base.

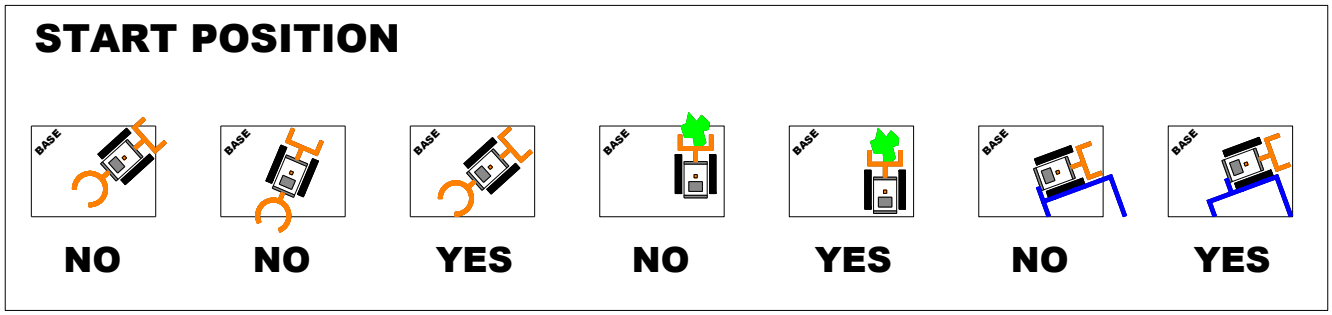
- **Stored Objects** – You may at any time, in Base, or storage areas, handle stored objects the robot is not currently touching or using. Stored objects are not allowed to make contact with anything outside Base except other stored objects, and the movement of stored objects is not allowed to be strategic in any way.
- **Inactive Robot Handling** – During setup, and whenever else the robot is inactive, you may repair it, aim it, switch attachments, select programs, reset features, and load/unload cargo in Base, or other storage areas.
- **Aiming** – You may use a frame/"jig" to aim the robot, but its use must be completely in Base at all times, and you must let go of it prior to starting/restarting.
- **Staging** – You are allowed to place objects in the robot's path, completely in Base only.
- **Chain Reactions** – If moving the robot by hand outside Base will unavoidably allow/cause the movement of any non-cargo object, such as something being "held up" or "held back," the movement of that retained object (the chain reaction) must be kept to an absolute minimum. Allow the stored energy to dissipate slowly over as little distance as possible.
- **Strategic Rescue** – Stopping the robot during a strategically precise window of opportunity for progress toward a mission task is not allowed.
- **Broken Robot** – You may at any time recover pieces of an obviously broken robot.

17 – STORAGE AND WORKSPACE

- Once the ref inspects your equipment, you may store things as needed in Base, or in a box, or by hand, or possibly on a stand, if stands are allowed at your event (decided by your tournament's officials – check with them in advance).
- If you feel crowded in Base, storage and handling of the robot and other objects may extend over/outside Base lines, as long as there is absolutely nothing strategic or disruptive about the placement.
- Mission models and objects worth points in Base must always stay in view of the ref.
- Nothing is allowed on the floor.

18 – START/RESTART POSITION

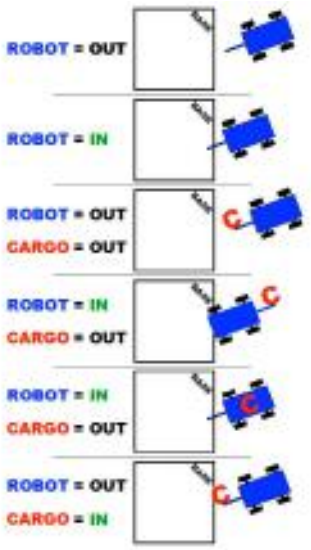
- For the match start and all restarts, EVERY BIT of the robot, including its installed attachments & wires, everything touching it, and any objects it is about to move or use, must ALL fit COMPLETELY in Base.
- The ROBOT MAY be touching objects it is about to move or use.
- YOU may NOT be touching objects the robot is about to move or use.
- YOU may NOT be touching objects the robot is touching.
- Everything must be motionless.
- All mission models in Base must be able to pass the gravity test.



19 – STARTING PROCEDURE

- For the match start, the ref checks that things are in proper starting position, then signals your readiness to the announcer.
  - As the countdown starts, you reach in with one hand, ready to either touch a button, or signal a sensor, to start or resume the robot's program.
  - When you hear the sound, you activate (start) the robot. The exact time to start is at the beginning of the last word in the countdown, such as "Ready, set, GO!"
  - If a non-word signal is used, like a beep or buzzer, the start is at the beginning of that signal.
  - You may not handle the robot or anything it's about to move or use during the countdown, except for the single action needed to get the program running. If you do, the ref has you restart.
- For all other starts (called restarts), there's no countdown. The ref watches to be sure things are in proper starting position, and you activate the robot when you decide.
- If the robot enters and leaves Base with no interruption or influence from you, this is not considered a restart, so starting position is not required.

20 - TOUCH PENALTIES (this rule is about what happens when you touch the robot)



- If you touch the active robot or anything it's touching while the ROBOT is completely outside Base, you get a "touch penalty" (identified in the Missions).
- If you touch the active robot or anything it's touching while its CARGO is outside Base:
  - if the robot had the cargo the most recent time the robot was in Base, the cargo goes back to Base.
  - otherwise the ref keeps the cargo.
- Warning: Avoid touching a robot entering Base until its cargo has also reached Base!
- If the only part of the robot in Base at the time of the touch is a cord, hose, wire, tube, chain, string, or other feature obviously used purely for avoiding a touch penalty, you get a touch penalty anyway.
- In rare situations when the robot is outside Base, straining its motors, and no longer traveling, you may non-strategically shut it off and leave it in place with no penalty.

21 – FAILURE AND LOSS (this rule has nothing to do with you touching the robot)

- Anything (allowable) done to your field outside Base stays that way, unless the ROBOT changes it.
- Objects moved/left outside Base are not replaced or moved out of the way by hand.
- Damage and chaos caused by an active robot are not repaired or reset by hand.
- Cargo the robot loses contact with is left wherever it comes to rest (if it goes off the table, the ref keeps it).
- This means the robot can ruin its own opportunity to accomplish tasks, and it can even spoil previous results.

Exception: Parts not designed to separate from the robot, but which separate due to obviously accidental DAMAGE may be recovered by YOU, by hand, at any time – even if they have cargo (gift: you keep any cargo in question).

22 – MODEL DAMAGE

- This is when a model outside Base is made defective and/or its Dual Lock is separated by an active robot.
- Model damage is not repaired during the match.
- If a model is manipulated into a scoring condition, but gets damaged
  - during the process, the condition is marked scoreless.
  - during an obviously unrelated action later (even seconds later), as long as the scoring condition is visible it can still score.

- Any scoring success which obviously depended on model damage is marked scoreless.
- This means the robot can ruin its own opportunity to accomplish tasks, and it can even spoil previous results.
- Any model damage obviously due to poor setup or lack of maintenance is treated with benefit of the doubt.

23 – REVERSIBILE ACCIDENTS

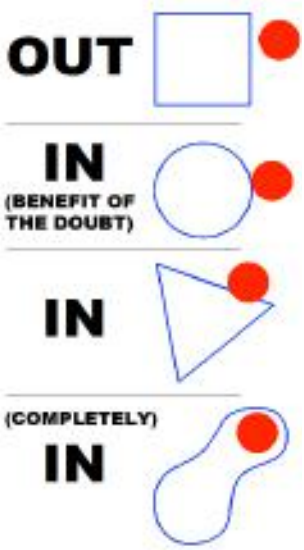
- When things such as a sleeve, table-bump, or illegal action disturb the field in any way, the ref physically reverses the change if he or she feels that's easy. If the change is too hard to undo…
  - o if the accident was the team's fault, negative scoring effects stand, and positive scoring effects do not.
  - o If the accident not the team's fault, the team gets benefit of the doubt on all related scoring questions.

24 - INTERFERENCE

- Your robot may not have any effect on the other team's robot, field, or strategy except near the model(s) shared between both teams, where accidental interference is expected and acceptable.
- If Robot X deliberately blocks or un-scores Robot Y's progress/results, Robot X's mission(s) in that area are marked no score, and Robot Y's are marked as complete.
- If two robots become entangled, they are both allowed to restart without penalty. Any cargo involved is given to the team in Base, whether or not it has ever been there before.
- As a matter of luck, the other team might out-perform you in a competitive interactive mission, or might fail to help you in a cooperative interactive mission. The net effect is the same, and this is not considered interference.

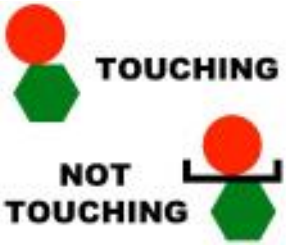
25 – IN

- **A** is "in," "into," or has "reached" **B** if any bit of **A** is directly over or under **B**.
- Barely "in" is considered "in" unless "completely "in" is required.
- **A** can be "in" **B** without touching **B**.
- Objects are ruled on independent of each other, and independent of their transports/containers.
- "Outside" is the opposite of "in" and means completely out.



26 – TOUCHING

- **A** is "touching" **B** only if **A** is making direct contact with **B**. Exception: If **B** were your hand, both examples would count as touching, since even an indirect touch from your hand is considered a touch.
- Any amount of direct contact counts as touching.



27 – SCORING

- Unless a specific method is required, your score is assessed based on the conditions at the exact time the match ends only.
- Points are not given for results the robot produces during the match but then trashes before the end.
- Points are not given nor taken away for results produced after the match end signal ends.
- When a mission is required to be achieved through a specific method, but is achieved by some other method, it is marked scoreless.

28 - AFTER THE MATCH

- No one is allowed to touch anything on the field yet:
- The ref first needs time to record the condition of the field, and come to agreement with you (kids only) about what points were scored or missed and why (and to be sure you're not walking away with any of that field's mission models!). Data is marked on a sheet which you initial, making the sheet final.
- The scores are tallied by computer, with ties being broken using 2nd, then 3rd highest scores. If more than one team gets a perfect score in all regular rounds, tournament officials decide what to do. Options include a variety of playoffs, or simply awarding multiple same-place awards.
- Don't walk away with mission models from the competition area. Bring them back if you do. Thanks.

29 - BENEFIT OF THE DOUBT

- You get the benefit of the doubt when:
  - o incorrect/poor model setup or maintenance is the obvious cause.
  - o a split-second or the thickness of a (thin) line is a factor.
  - o a situation could "go either way" due to confusing, conflicting, or missing information.
  - o a ref is tempted to rule based on the "intent" of a requirement or constraint.
  - o no one's really sure WHAT just happened!
  - o If you (kids, not coach) disagree with the ref and can respectfully raise sufficient doubt in his/her mind during your post-match chat, your ref meets with the head ref, and the resultant decision is final. This rule is not an order for the refs to be lenient, but for them to rule in your favor when they've done all they can to rule correctly, yet the answer's still unclear.

30 - DOWNLOADING

- Downloading programs to robots may take place in the pits only - never in the competition area.
- Always download by cable. Bluetooth must be switched off at all times.

31 – VARIABILITY

- As you build and program, keep in mind that our suppliers, donors, and volunteers make every effort to ensure that all fields are correct and identical, but you should always expect some variability, such as:
- flaws in the border walls.
- variety in lighting conditions, from hour to hour, and/or table to table.
- texture/bumps under the mat.
- presence or absence of tape at the East and West edges of the mat.
- waviness in the mat itself. At many tournaments, it is impossible for the mats to be rolled out in time to lose their waviness. Location and severity of waviness varies. You are being warned here. Consider this while designing.
- Two important building techniques you can use to limit the effects of variability are:
  - o Avoid steering systems that involve something sliding on the mat or border walls.
  - o Cover your light sensors from surrounding light.
- Questions about conditions at a particular tournament should only be directed to that tournament's officials.

32 - PRECEDENCE/AUTHORITY

- Once in a while, you'll see conflict within or between different robot game documents. So here is the order of precedence for the sources:
  1 = CURRENT **Robot Game Updates**, 2 = **Missions** and **Field Setup**, 3 = **Rules**
- If something on a page conflicts with something else on the same page, the most sensible interpretation is assumed. If two interpretations seem equal, the interpretation most favorable for the team is assumed.

- On all pages, videos and pictures are for guidance and example only. Often they can not express complete information, and are therefore misleading. When there is conflict between pictures/videos and text, the text takes precedence!
- The head ref at a tournament is required to base decisions on the information above, in the order shown above. No other source of information is official, including e-mails from Robot Game Support.

33- ROBOT GAME SUPPORT

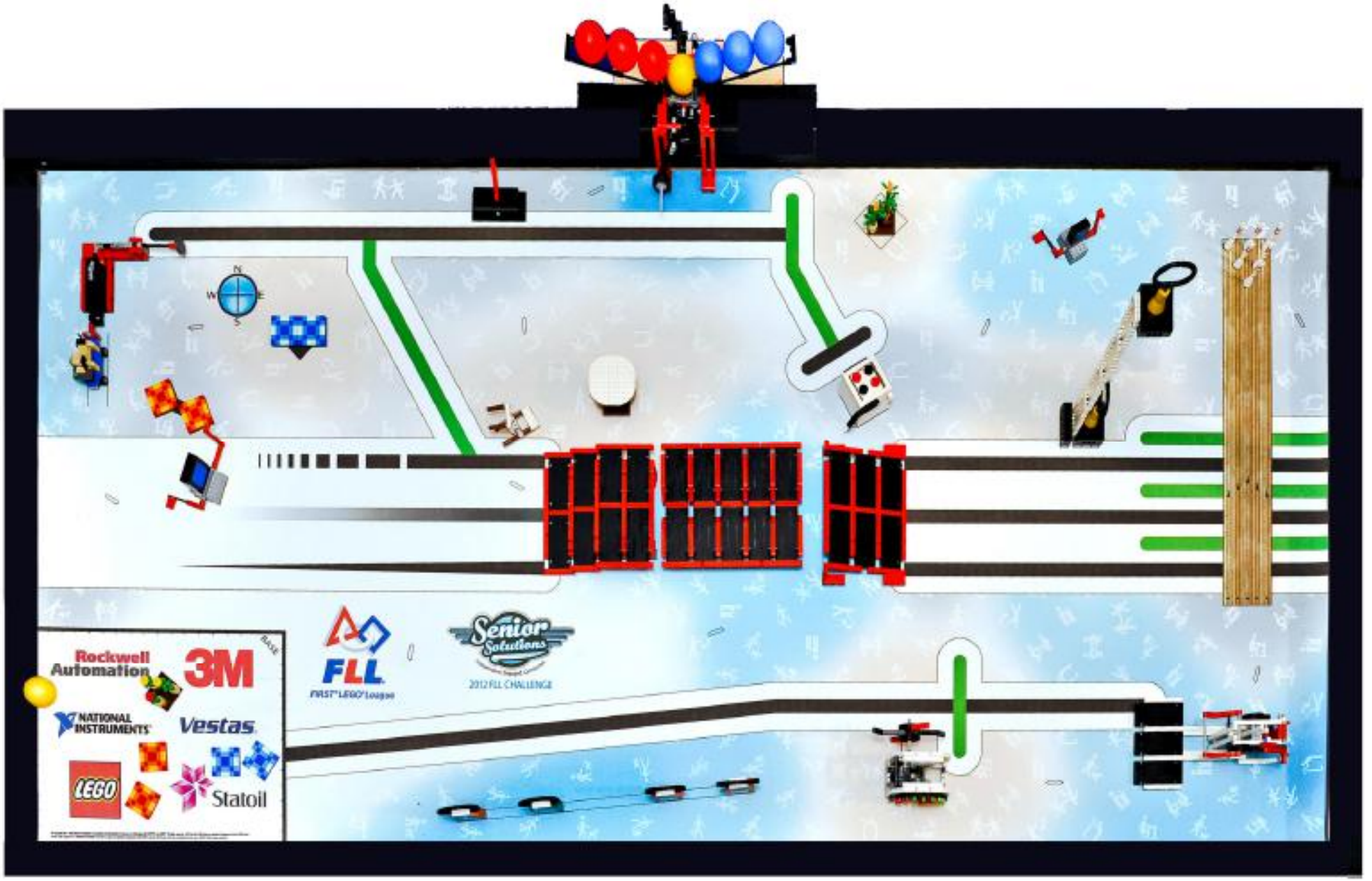
- The best first place to go for Robot Game support is the Robot Game Updates page.
- If that doesn't help, expert support is available directly from the designer/author (Scott – Hi!) at **fllrobotgame@usfirst.org** (usual response in 1-2 business days).
- When e-mailing, please state your role in FLL (member, coach, parent, mentor, referee, Partner).
- No question is a bad question, but some are much better than others!
- If it's obvious you're not at least a little familiar with the text of the various important pages, you'll be referred to it.
- If you're not sure how to interpret or apply a particular bit of text, you'll be told how a good referee likely would.
- If you expose missing or problematic text so common or severe as to potentially cause problems at events, an addition, correction, or ruling will be posted on the Updates page.
- Questions organized into short simple parts get the fastest and most useful answers.
- Tournament refs are not obligated to read individual response e-mails.
- No new Robot Game Updates are posted after 3PM (eastern U.S.) on Fridays.
- You won't get help/advice about building or programming (that's your challenge).
- Questions about LEGO product in general get redirected: Instead call (U.S.) 1-866-349-LEGO.
- Questions posted in the discussion forum are not seen nor responded to by Robot Game Support.

WARNING: The forum is great for sharing ideas and getting tips from other teams, but it is not an official source of answers about anything.

34 - COACHES' MEETING

- If a question does come up right before the tournament, your last chance to ask it is at the "Coaches' Meeting" (if there is one) the morning of the tournament.
- The head ref and coaches meet to identify and settle any differences BEFORE the first match.
- For the rest of the day, the ref's calls are final when you leave the table.

CHANGES FOR 2012

- There are no more quantity limits on sensors.
- The robot is defined.
- It's now clearly okay to shut off the robot when you're "done" and not get a touch penalty.

2012 SENIOR SOLUTIONS℠ FLL® Challenge Field