

# *FIRST*® LEGO® League (FLL®)

## Introduction For Coaches

Tony Ayad and  
LeRoy Nelson

### Outline

#### *FIRST* LEGO League

- Teams & Requirements
- Robot Sets
- The Challenge
- Competition and Judging
- Competition Progression
- Season Calendar
- Expectation
- Tips
- Resources

#### Basic NXT Programming

- NXT Controller  
(aka: the "brick")
- NXT-G Interface
- MOVE, MOTOR &  
ROTATION SENSOR  
Blocks
- Turns
- Applying Math &  
Geometry concepts

**FIRST®**

- **FIRST: For Inspiration and Recognition of Science and Technology**
  - It is about encouraging kids to learn about Science, Technology, Engineering and Math (STEM) through a robotic game
  - Founded by Dean Kamen, inventor of the Segway
- **FIRST® Robotics Competition (FRC®)**
  - Winter advanced robotics program for high school students
- **FIRST® Tech Challenge (FTC®)**
  - Fall basic robotics program for high school students
- **FIRST® LEGO® League (FLL®)**
  - Fall robotics and research program
  - 20,000+ Teams of 2-10 young people ages 9-14 in 70+ countries
- **Junior FIRST® LEGO® League (Jr.FLL®)**
  - Fall/winter research and LEGO® building program
  - 3,600 teams of 2-6 children ages 6-9 in 12 countries

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**FLL Core Values**

- We are a team.
- We do the work to find solutions with guidance from our coaches and mentors.
- We know our coaches and mentors don't have all the answers; we learn together.
- We honor the spirit of friendly competition.
- What we discover is more important than what we win.
- We share our experiences with others.
  - Reinforce what they learned, improve presentation skills, especially to adults
- We display Gracious Professionalism® and Coopertition® in everything we do.
  - Work like crazy, but treat one another with respect and kindness.
- We have FUN!

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## Team Requirements

- Team Size
  - Ideal size is 4-7 kids with one coach and one robot set
  - Larger teams may need additional mentors and/or additional robot sets
- Where to meet
  - Safe area large enough for the number of kids on the team
    - Classroom, garage, large living room or family room
  - Field table (4'X8') and a computer
    - Official wood table is more durable; rigid foam table is more portable
    - Laptop computer preferred, so you can take it to events
    - Internet access preferred for research
  - Storage space for the field table, field setup kit, robot set and robot (between meetings)
  - For first year team, one robot set is enough
- Snacks: Have parents bring snacks to get/keep them involved

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## Robot Sets

- Three different version of LEGO® MINDSTORMS® are available:
  - Robotics Invention System with RCX brick and ROBOLAB software (1998)
  - NXT with NXT-G software (July 2006—mid 2015)
  - EV3 with EV3 software (August 2013)
- FLL NXT Robot Set (\$435):
  - NXT Education Base Set
  - NXT Education Resource Set
  - NXT Education Software with team license requires Windows XP, Vista or MacOSX
- FLL EV3 Robot Set (\$499):
  - EV3 Core Set
  - EV3 Expansion Set
  - EV3 Software with team license requires Microsoft Dot Net 4.0 and Windows XP, Vista, Windows 7 or Windows 8; or Silverlight 5.0+ and Mac 10.6, 10.6 or 10.8

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## EV3 New and Improved Hardware and Software

- A gyro sensor in addition to improved color/light sensor, ultrasonic and touch sensors
- A ball wheel for ultimate precision
- Two different motor sizes
- Extended on-brick programming
- Step-by-step tutorials making it possible for students to build and program a fully functional robot within 45 minutes
- Software that allows the teacher to customize and differentiate content
- A digital workbook making it possible to capture and assess student work
- The NXT brick, sensors and motors can be used with EV3 software

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## Team Leadership Roles

- Purchaser
  - Secures funding from sponsors, parents, parents' employers
  - Registers the team and the coaches
  - May also be the coach
- Coach
  - Must be an adult
  - Organizes the team and meetings and ensures the team is progressing
  - Serves as a good role model and instills team spirit
  - You don't have to be an engineer to be a great FLL coach
- Assistant Coach (optional)
- Mentor (optional)
  - Technical person to explain engineering and programming concepts
- Remember that the kids do the work!
- Although one person can do everything, get help!

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## The Challenge

- Includes a robot game, a research project and core values
- A different scientific or engineering theme every year
- Real-world community-based problems and solutions
- Stresses creativity and teamwork
- Teams use engineering processes: define problem, requirements, alternatives, solution, plan, presentation, ...
- Multiple roles are needed: designers, builders, programmers, researchers, presenters, ...
- Timing:
  - Team registration from early May through late September
  - Challenge released in late August or early September on <http://www.firstlegoleague.org/>
  - Season ends for most teams in November or December

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## 2013 Challenge – Nature’s Fury<sup>SM</sup>: Prepare. Stay Safe. Rebuild.

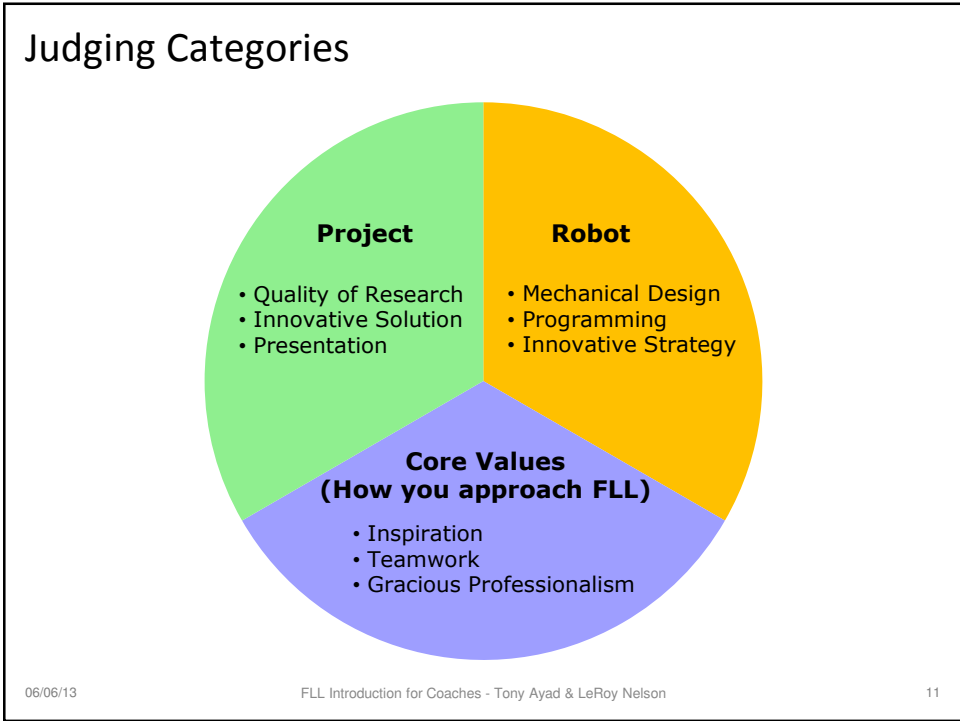
Can *FIRST*<sup>®</sup> LEGO<sup>®</sup> League teams help us master natural disasters? In the 2013 NATURE’S FURY<sup>SM</sup> Challenge, over 200,000 children ages 9 to 16\* from over 70 countries will explore the awe-inspiring storms, quakes, waves and more that we call natural disasters. Teams will discover what can be done when intense natural events meet the places people live, work, and play. Brace yourself for NATURE’S FURY! FLL challenges kids to think like scientists and engineers. During NATURE’S FURY, teams will build, test, and program an autonomous robot using LEGO MINDSTORMS<sup>®</sup> to solve a set of missions in the Robot Game. They will also choose and solve a realworld problem in the Project. Throughout their experience, teams will operate under FLL’s signature set of Core Values.

\*9-14 in the US, Canada, and Mexico

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- ### Project (Required for award consideration)
- **Research**
    - **Problem Identification:** Clear definition of the problem being studied
    - **Sources of Information:** Types and quality of sources, including experts
    - **Problem Analysis:** Depth to which problem was studied and analyzed
    - **Review Existing Solution:** Analyze existing solutions, verify originality
  - **Innovative Solution**
    - **Team Solution:** Clear explanation of the proposed solution
    - **Innovation:** Team’s solution improves existing options, develops new application of existing ideas, or solves problem in completely new way
    - **Implementation:** Consideration of factors for implementation
  - **Presentation**
    - **Sharing:** Team shared presentation with others who might benefit
    - **Creativity:** Imagination used to develop and deliver the presentation
    - **Presentation Effectiveness:** Message delivery and organization
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## Robot Design

- **Mechanical Design**
  - **Durability:** Structural integrity; able to withstand rigors of competition
  - **Mechanical efficiency:** Economic use of parts and time; easy to repair and change
  - **Mechanization:** Move with appropriate speed, strength and accuracy
- **Programming**
  - **Programming Quality:** Appropriate and achieves results consistently
  - **Programming efficiency:** Modular, streamlined and understandable
  - **Automation/Navigation:** Moves or acts as intended using mechanical or sensors feedback
- **Strategy and Innovation**
  - **Design Process:** Improvement cycles, alternatives, selections tested
  - **Mission Strategy:** Clearly define and describe team's game strategy
  - **Innovation:** New, unique or unexpected beneficial features

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## Core Values (How the team works on the Challenge)

- **Inspiration**
  - **Discovery:** Balanced emphasis on Robot, Project and Core Values
  - **Team Spirit:** Enthusiastic and fun expression of the team identity
  - **Integration:** Application of FLL values and skills outside FLL
- **Teamwork**
  - **Effectiveness:** Problem solving and decision making processes
  - **Efficiency:** Time management, roles and responsibilities
  - **Kids do the work:** Appropriate balance between team responsibility and coach guidance
- **Gracious Professionalism**
  - **Inclusion:** Consideration and appreciation for the contributions of all team members, with balanced involvement
  - **Respect:** All feel valued when solving problems, resolving conflicts
  - **Coopertition®:** Friendly competition and cooperates with others

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## Judging Rubrics

- Rubrics for Robot Design, Project and Core Values
- Four levels of accomplishment for each skill area/category
- ND = Not Demonstrated
- Judges' comments on special accomplishments or suggestions for improvement
- Nominations for award consideration

		FLL Core Values		Team Number	
		FIRST LEGO League		Judging Room	
Directions: For each skill area, clearly mark the box that best describes the team's accomplishments. If the team does not demonstrate skill in a particular area, then put an "X" in the first box for Not Demonstrated (ND). Please provide as many written comments as you can to acknowledge each team's hard work and to help teams improve. When you have completed the evaluation, please circle the awards for which you would like this team to be considered.					
		Beginning	Developing	Accomplished	Exemplary
Inspiration	Discovery	Balanced emphasis on all three aspects (Robot, Project, Core Values) of FLL; it's not just about winning awards			
	N	emphasis on only one aspect; others neglected	emphasis on two aspects; one aspect neglected	emphasis on all three aspects	balanced emphasis on all three aspects
Inspiration	Team Spirit	Enthusiastic and fun expression of the team identity			
	N	minimal enthusiasm AND minimal identity	minimal enthusiasm OR minimal identity	team is enthusiastic and fun; clear identity	team engages others in their enthusiasm & fun; clear identity
Inspiration	Integration	Application of FLL values and skills outside FLL ability to describe current and potential examples from daily life			
	N	team does not apply FLL values and skills outside FLL	team able to describe at least one example	team able to describe multiple examples	team able to describe multiple examples, not individual issues
Comments:					
Teamwork	Effectiveness	Problem solving and decision making processes help team achieve their goals			
	N	team goals AND team processes unclear	team goals OR team processes unclear	clear team goals and processes	clear processes enable team to accomplish well defined goals
Teamwork	Efficiency	Resources used relative to what the team accomplishes (time management, distribution of roles and responsibilities)			
	N	limited time management AND unclear roles	limited time management OR unclear roles	excellent time management and role definition allows team to accomplish most goals	excellent time management and role definition allows teams to accomplish all goals
Teamwork	Kids Do the Work	Appropriate balance between team responsibility and coach guidance			
	N	limited team responsibility AND excessive coach guidance	limited team responsibility OR excessive coach guidance	Good balance between team responsibility and coach guidance	team independence with minimal coach guidance
Comments:					
Gracious Professionalism™	Inclusion	Consideration and appreciation for the contributions (ideas and skills) of all team members, with balanced involvement			
	N	unbalanced team involvement AND lack of appreciation for contributions	unbalanced team involvement OR lack of appreciation for contributions	balanced team involvement AND appreciation for contributions of most team members	balanced team involvement AND appreciation for contributions of all team members
Gracious Professionalism™	Respect	Team members all and speak with integrity so others feel valued- especially when solving problems or resolving conflicts			
	N	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	always evident, even in the most difficult situations
Gracious Professionalism™	Cooperation™	Team competes in the spirit of friendly competition and cooperates with others			
	N	not evident with majority of team members	evident with majority of team members	almost always evident with all team members	always evident, even in difficult situations- and team actively helps other teams
Comments:					
Awards Consideration:		Inspiration	Teamwork	Gracious Professionalism™	

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## Core Awards Based on Judging Categories

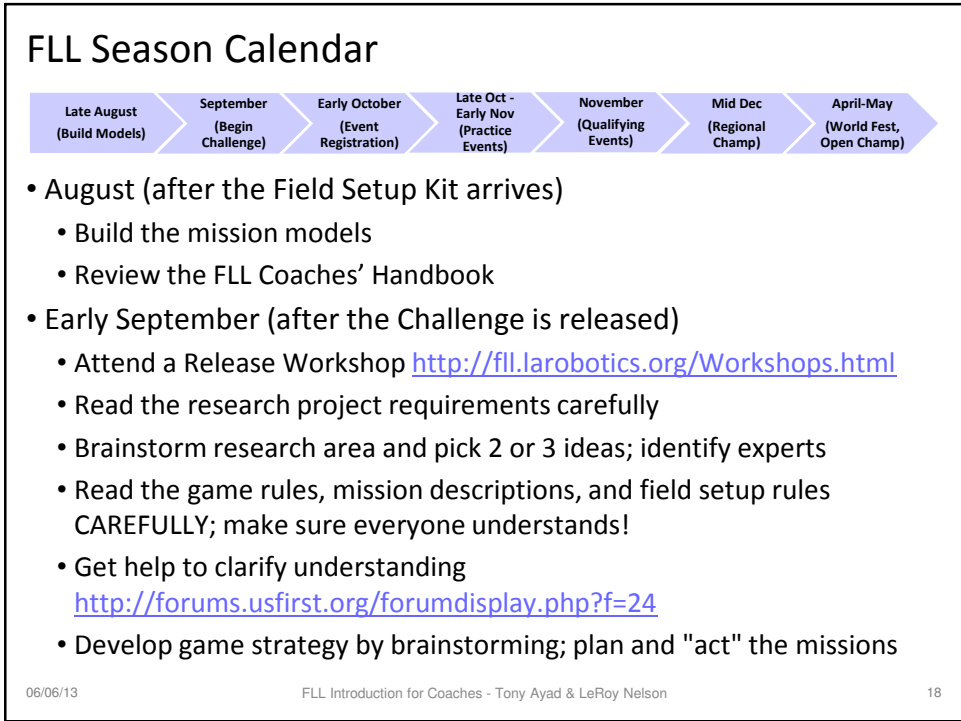
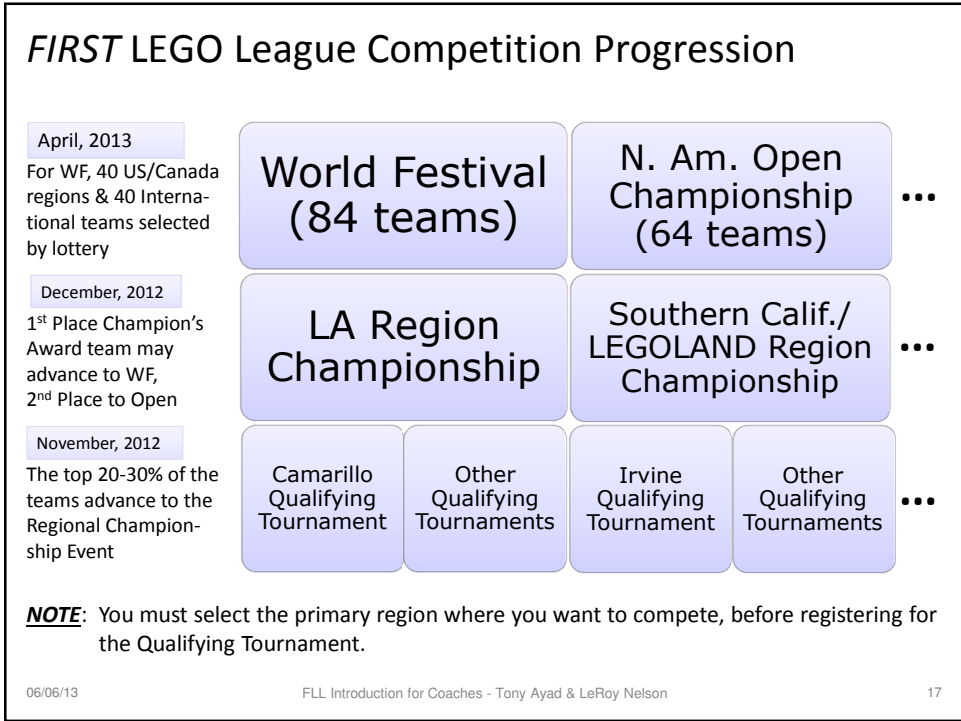
- **Robot Performance Award:** highest robot performance scores
- **Judged Awards** (only one per team):
  - **Champion's Award:** best overall team in all areas
  - **Mechanical Design Award**
  - **Programming Award**
  - **Strategy and Innovation Award**
  - **Research Award**
  - **Innovative Solution Award**
  - **Presentation Award**
  - **Inspiration Award**
  - **Teamwork Award**
  - **Gracious Professionalism Award**
- Some awards may be combined for small events

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## FLL Season Calendar



- **September – October**
  - Choose team name and T-shirts to wear to events
  - Design, build, program and test the robot
  - Complete research, develop solution, select presentation style
- **Early October**
  - Sign up for a Practice Tournament (optional, but highly recommended)
  - Sign up for a Qualifying Tournament
- **Late October – Early November**
  - Participate in Practice Tournament
  - Refine project presentation, share what you learned, improve the robot
- **November**
  - Participate in Qualifying Tournament

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## Expectations

- It takes a lot of time to complete the research project, to design, build and program the robot, and to practice for the competition
- Rookie teams should plan on meeting at least 4 hours per week
- Team members should work on the project as homework at least 1 hour per week
- 40-60 hours total over 10-12 weeks in September - November
- Discuss with parents to ensure they understand the commitment
- One or two kids may drop out, so have a backup plan
- Divide and conquer
  - Everyone may not program or build, but
  - Everyone needs to do their share of the research project and
  - Everyone needs to participate in developing the robot game strategy

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## Running Team Meetings

- Work with team members to come up with rules for your team at the first meeting
- Review team calendar with team (and parents) in early September
- Have the kids set goals for each meeting (5-10 minutes)
- Help create sub teams to organize the work
- Have the kids assign tasks to each person or sub team
- Review progress at the end of each meeting
- Assign tasks to be done between meetings
  - Project tasks (research and presentation) are good candidates
- Challenge the team and ask probing questions to guide the kids to their own answers instead of telling them your ideas
- Be aware of team dynamics to minimize cliques, conflicts
- Leaders will emerge!

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## Tips – Project

- Read the description, updates/FAQ and rubrics carefully as a group and perform preliminary research to pick a specific project topic
  - When in doubt, read and re-read ... and get help!
  - Check for changes to Updates/FAQ
- Meet with experts as soon as possible to understand the issues and areas where the team may decide to focus / select a specific project
  - Since the topic this year is about natural disasters, ask any first responders, Red Cross volunteers, etc. that you know if the team could talk to them
- Most of the project work can be done outside the team meetings
  - Save meeting time for shared understanding and brainstorming ideas
  - Ensure that each team member is assigned a share of the work
  - All kids need to participate in the research, creation of props, charts, models, etc.

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## Tips – Project

- Plan on completing the research in the first half of the season
- Allow at least 2 weeks for preparing the presentation and practice
- Pick a presentation style that is suitable for the team and entertaining for the judges
  - Judges like to see and hear the kids perform live, not watch videos or PowerPoint presentations
- Since hearing can be a problem for some venues and for some judges, make sure all of the major presentation points are presented visually as well as spoken
  - Give the judges a printed summary of the presentation
- Keep the setup simple, because setup time counts as part of your presentation
  - Judges can see a laptop screen as well as a projection screen

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## Tips – Robot Game Preparation

- Study the Missions, Field Setup, **Rules**, Rubrics and Updates carefully as a team
  - Review them every 2-3 weeks
  - If in doubt, check the Forum and submit questions to get answers
  - Check for revised Robot Game Updates weekly
    - Updates sometimes change the rules significantly!
- Check the placement of the mat and missions on the field table per the Rules and Field Setup before practice or programming
- Make sure the battery is fully charged before each meeting
- Remember the KISS rule: Keep it simple, silly!
  - There is limited time available to design, build and program the robot
- Consider different wall heights (2.5" or 3.5") and table sizes
  - The tables at LEGOLAND were built to fit the mat, so they are smaller

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## Tips – Robot Game Strategy

- Develop a **strategy** for maneuvering the robot on the field that maximizes the number of points yet is simple enough to complete consistently within 2½ minutes
  - ALL team members should participate in this activity
  - Help the team set the right expectation and **not** plan on programming ALL the missions their first year
  - Start with the easy missions and make sure they are done consistently before going on to harder missions
- Group missions in same field area to reduce the number of trips
  - Look for clear paths
  - Plan each trip by measuring the distance traveled to each turn
  - Plan and divide the work among individuals or sub-teams
  - Review the plan before the kids start programming to reinforce the “planning” concept

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## Tips – Robot Design

- Robot base
  - Balance most of the robot’s weight on the drive wheels
  - Use rechargeable battery and recharge if voltage falls below 7.9 volts
  - Caster wheel warning: great for turning, horrible for aligning
- Arms, attachments and mechanisms
  - Plan for deviations when building attachments: make them wider
  - Combine functions to minimize exchange time and returns to base
  - You have only one motor to power all attachments and mechanisms
- General
  - The simpler the better to accomplish the missions
  - Have the team review robots on YouTube to get ideas
    - Search: *FIRST* LEGO League, not FLL (Fort Lauderdale Airport)
  - Make sure components do not come apart after a few trials
- Robot Design Executive Summary

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## Tips – Programming

- Verify that all files are backed up before programming starts!
- Save programs often; save working programs with special names
- Do not program when battery charge is below 7.9 volts
- If the robot can execute a program successfully 3 times in a row with two different operators, it is done (the coach is the arbiter)
- Add comments to the programs to describe what blocks do and why
  - E.g., “Turn right to face the base”
- If possible, design programs so that the robot always starts from the same position in base to eliminate confusion during competition
- Accept this fact: The more turns and movements in a program, the more deviations will occur!!!
  - Use the field table borders or missions models to re-orient the robot
  - Use sensors

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## Tips – Core Values

- Encourage team members to learn the Core Values
  - Post them in your meeting room
  - Knowing them will really impress the judges!
- Discuss one Core Value at each meeting
- Review Rubric
- Teamwork exercise
  - At Championship and some other events
- Core Values Poster
  - The thought that goes into preparing the poster will prepare your team for the interview with the judges
- Team Information Sheet – bring four copies for judges and emcee
- Coach’s Promise – bring signed forms to registration
- *FIRST* Consent and Release Forms – bring signed forms to registration

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## Los Angeles Region FLL Resources

- New Teams web page:  
<http://fll.larobotics.org/NewTeams.html>
  - Teams
  - Team Costs
  - The Season
  - Team Grants
  - Links to the official FLL websites
  - First Steps for New Teams
  
- Team Resources web page:  
<http://fll.larobotics.org/Resources.html>
  - Field Table
  - Links to other resources
  - Recommended Books
  - Forms for Tournaments
  - Coach Training Slides (including these)
  - Teams Google Group
  - Coach Calls
  - Fundraising
  - Coach Training Workshops and Robotics Classes and Summer Camps

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## FLL Resources

- FLL Team Registration includes:
  - FLL Coaches' Handbook
  - FLL Project Training DVD
  - Information cards for parents
  - *FIRST* Compilation DVD
  - Gracious Professionalism® Poster
  - 2 FLL Pins for Coaches
  
- FLL Team Resources Page:  
<http://www.firstlegoleague.org/challenge/teamresources>
  - Stay Connected with FLL
  - Project
  - Coaches' Handbook
  - Robot Game
    - Building
    - Programming
    - Curriculum
  - FLL Products
  - Table Construction: Official; portable
  - Storage During Competition
  - Engineering & Career Resources
  - Coach Calls
  - Fundraising

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## Coach Calls

- Recorded live each season, but most content does not change much
- Where Do I Start? Coach Orientation
- Coaching A Team
- Basic Programming: Tips, Skills & Resources (coming next)
- The Robot Game
- The Project
- Core Values/Teamwork
- Robot Design
- Judging: A Perspective for the Coach
- Preparing for an FLL Event
- FLL to FTC
- FLL Global Innovation

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