Steps for Starting a WRO Robotics Program

Congratulations on your decision to start a WRO robotics program! Whether you are a teacher, parent, coach, or an after-school club leader, you'll find lots of support as you move through this process.

WRO has compiled this comprehensive, step-by-step plan to help guide you through the process. All steps are relevant to teachers, parents, coaches and club leaders. Teachers will also need to decide on the education-specific-outcomes they are trying to achieve, as well as how WRO robotics aligns with their school's standards.

Step-By-Step Organizer:

1. Choose an age group

Decide the age group(s) of WRO competition(s) you wish to participate in:

Age Group A	WeDo (up to 10* years old)
Age Group B	Elementary (Up to 12* years old)
Age Group C	Middle School/Junior High School (13-15* years old)
Age Group D	High School (16-19* years old)
Age Group E	College/University Group (17-25* years old)
Age Group F	GEN II Football/Soccer (10-19* years old)

**Maximum age of student in the year of the International Competition*

2. Choose a category

Decide on which category you are interested in.

Regular Category	***Open Category***	***Football/Soccer Category***
Build and program a robot to solve a challenge. Age Groups: A, B, C, D & E	Build and program a robot that represent the International Competition Theme. Age Groups: A, B, C, & D	Build and program a robot to play football/Soccer. Age Group: F

The chart below summarizes Age Groups and Competition Categories:

	Regular Category	Open Category	Football Soccer
Age Group A (up to 10*)	X	X	
Age Group B (up to 12*)	X	X	
Age Group C (13-15*)	X	X	
Age Group D (16-19*)	X	X	
Age Group E (17-25*)	X		
Age Group F (10-19*)			X

(*Maximum age of student in the year of the International Competition)

3 Choose Hardware

Select the hardware that the student will use to build the robot(s) as well as a programming language that will be appropriate for controlling the robot(s).

Be sure to follow the WRO Guidelines for these choices:

WeDo REGULAR COMPETITION (Age Group A)

i The controllers, motors and sensors used to assemble the WeDo robot must be from the LEGO® Education WeDo 2.0 Core Set. Any number and combination of controllers, motors and sensors are allowed. Any LEGO® branded non-electrical/non-digital elements can be used in the construction of the robot.

REGULAR COMPETITION (Age Groups: B, C, and D)

i. The controller, motors and sensors used to assemble robots must be from *LEGO*® MINDSTORMS™ sets (NXT or EV3) and the *HiTechnic* Color Sensor. Other *LEGO*® Branded Elements may be used to construct the remaining parts of the robot. The motors and the sensors for the robot must be procured from *LEGO*® and *HiTechnic*.

ii. Control software must be either *ROBOLAB*® *NXT*®, *EV3* software, or *LabVIEW.**

	Robolab	NXT Software	EV3 Software	Labview*
NXT	☑	☑	☑	☑
EV3	÷	÷	☑	☑

**LabVIEW* is ONLY permitted in the High School age group

WeDo OPEN COMPETITION (Age Group: A)

i The controllers, motors and sensors used to assemble the machinery/robots must be from the LEGO® Education WeDo 1.0/2.0 Core Sets. Any number and combination of controllers, motors and sensors are allowed. Any LEGO® branded non-electrical/non-digital elements can be used in the construction of the machinery/robot and the environment.

ii The machinery/robot can be controlled by any compatible device using the WeDo 1.0/2.0 software or with a remote controller built from WeDo 1.0/2.0 elements and controlled with WeDo 1.0/2.0 software.

OPEN COMPETITION (Age Groups: B, C, and D)

i There is no restriction on the balance between LEGO® elements and other materials.

ii All robots must be operated by NXT or EV3 controllers and any other materials.

COLLEGE/UNIVERSITY REGULAR COMPETITION (Age Group E)

i The controller used for the robot must be from National Instruments, MyRIO or KNR (MyRIO based), or the LEGO® *MINDSTORMS*™ NXT or EV3 systems.

ii The building system must be *MATRIX* or *TETRIX*.

iii Control software must be *LabVIEW* from National Instruments or any "C" language (like C, C++, C#, RobotC or NXC).

GEN II FOOTBALL/SOCCER COMPETITION (Age Group F)

i Materials allowed to construct the robots are LEGO® *MINDSTORMS*™

ii Controllers must be NXT and sensors must be from HiTechnic.

iii The official "Infrared Soccer Ball" must be from HiTechnic.

4 Determine the exact requirements of your competition(s).

The best source of information for each year's competition is the Event Website

http://www.wro2018.org

For all pertinent rules and procedures, download the *General Rules* and Standard *Operating Procedures* from:

http://www.wro-association.org

5 Determine composition and number of teams for each competition.

According to *World Robot Olympiad*™ *Standard Operating Procedures,* "…a team consists of one (1) coach and two (2) or three (3) team members [of appropriate ages].

6 Arrange for each team to have a coach or an assistant coach.

A The minimum age of a coach at an international WRO final is age 20 at the time of registration for the WRO final. Registration for the international WRO final ends 4 weeks before the first day of the WRO competition.

B Coaches may work with more than one team; however, each team needs to be assisted by a responsible adult. This person may be an Assistant Coach. Minimum age for Assistant Coaches is also age 20.

C Coaches may offer students advice and guidance prior to the competition, however during a WRO competition all work and preparation must be performed by the student members of the team.

7 Define roles of team members.

Team member roles include building, programming, and managing the project. Sometimes students will naturally determine their team role and other times the coach should provide guidance. Encourage girls to join the teams!

8 Identify technical and logistical requirements.

A **Robots:** There should be one robot for each team of 2-3 students. Also, the teacher should have several backup robots in case of emergency situations

B **Computers:** There should be one computer for each robot/ team of students. Most of the students' activity will be independent and self-directed as they program / test / debug their solutions multiple times during each session. Multiple computers will provide easy access to the programming language, eliminate "traffic jams" and inadvertently changing another team's program.

C Practice Area

- **i.** Room size and setup – The space should be large enough to accommodate all the student teams, computers, practice tables, and storage area for the robots.
- **ii.** A Competition Table is required. The table should have borders to prevent robots from falling off. WRO playing field specifications require tables that have inner dimensions of 1150 mm x 2370 mm. One table can serve several teams in the same regular competition.
- **iii.** Competition Mat - Each January, WRO publishes the mat designs foreach new regular competition on the WRO event website. One mat per table per competition will serve several student teams.
- **iv.** Parts Storage – To keep parts organized and accessible for teams, parts organizers are necessary. There are many options…portable organizers, drawer cabinets, boxes, caddies, etc. These are readily available online and at local hardware and crafts stores.
- **v.** Network - The software will need to be loaded on each computer or available via a network for each computer. Programs should be included in the regular system backup or the coach should make a backup to a separate disk or memory stick.

9 Prepare a budget and secure funding

A typical budget for a WRO Competition will consist of robots, programming language, competition tables, competition fees, etc. The final cost for your WRO robotics program will depend on the number teams and the number of different categories you enter. Here are some typical costs to use when calculating your budget:

A Robots - One robot for every regular/open team (ie., for every 2-3 students)
LEGO® MINDSTORMS Education Base Set: $410.95
LEGO® MINDSTORMS® Education EV3 Expansion Set (1 for every 2 EV3): $103.95

or

LEGO® Education WeDo 2.0 Core Set: $189.95

B Programming Software Classroom License

LEGO NXT-G or EV 3: Free download

or

ROBOTC for LEGO MINDSTORMS: Free download

or

LabVIEW (an option for High School Regular Competition, only)

C Curriculum Classroom License (only for students with no experience)

i. For LEGO NXT-G (Optional)

Robotics Engineering Vol. I: $225 for a classroom license

Robotics Engineering Vol. II: $225 for a classroom license

ii. For ROBOTC (High School and College only)

Teaching ROBOTC for LEGO: $225 for a classroom license

D Storage bin/cabinets

This is a "must have" for any teacher implementing a WRO robotics program. Your costs will be dependent upon the selection of the cabinet and bin combination that you choose. The proper storage compartments as well as storage procedures will make teaching robotics much easier.

E Practice Table: up to $150 each depending on cost of materials and labor

F Playing Field Mat: up to $80 depending on local cost and printing fees

G Other: competition registration fees, team shirts, supplies, end-of-season party and awards, etc – up to $500 (depending on coaches' preferences.

H Potential Source of Funding

i. Local school district
ii. Local businesses
iii. Local non-profit organizations

(Be sure to acknowledge your sponsors at every opportunity, eg. print their names on your team shirts, etc.)

I Connect with the robotics educators' community locally and virtually

i. Find another WRO robotics team in your area and ask to attend their practice sessions. This is very helpful for first-time coaches.
ii. Robotics Educators Conference

Recap of the major steps to implement a WRO robotics program:

1. Purchase robot kits.
2. Purchase robotics curriculum (only for students with no robotics experience).
3. Load software (and curriculum, if needed) on your computer and school network.
4. Build a practice table and/or print a playing-field mat for each different competition category to be entered.
5. Schedule training… this can be self-paced by enrolling in the free online training.
6. Practice building and programming for the competition(s).
7. Recruit older students as mentors/assistants. Recruit parents as assistant coaches.

Activities for each session are determined by student abilities. If students are new to robotics and programming, introductory activities should be conducted from available curriculum sources (see Part 9C above). Once students have the basics of building and programming the robots, specific activities related to their category of competition should be implemented. The following addresses the latter situation.

For each session:

1. **Coach/Assistant Coach Preparation**
   A. Have the student teams choose a sequence of robotics activities appropriate for their competition. Discuss the sequence of activities with each team.

   or

   If students have no robotics experience, choose an appropriate activity from the purchased curriculum to help build their skill sets. B. Anticipate the student steps for each competition activity.

   or

   Make sure that each outcome of the curriculum project can be recognized when completed by the students and that appropriate help can be provided if the students become stumped.

2. **Session**
   A. Select an appropriate activity for each competition category.

   or

   Select an appropriate activity from the purchased curriculum.
   B. Direct students to the appropriate starting point at the beginning of the activity and let them begin.

3. **End of Activity**
   A. Observe the progress and/or completion of the activity by each team.
   B. Hold a discussion with each team to comment, discuss progress, and answer any student questions.
   C. Move on to next activity appropriate for the competition or curriculum.

4. **End of Session**
   A. Put the robots somewhere safe for next time the teams will meet. Or, if equipment is scare and is shared between teams, disassemble robots entirely for the next group to use.
   B. Clean up loose LEGO parts (use the sorting trays and bins).
   C. SAVE ALL PROGRAMS!

5. **Repeat Steps 1-4** as necessary depending on skills level of students and whether they are starting from “scratch” with a curriculum or working on an actual competition robot.

6. **End of Project - Final Competition Preparation**
   Give student teams adequate time to prepare for the local or regional competitions. There will be a lot of program “tweaking” and robot “fixes” before each team is set for the competition. Be sure to supply as much patience and encouragement as possible and realize this may be a stressful time for each team.