Organizational Suggestions
For
Running a Robotics Classroom

Congratulations on your desire to launch an iCarnegie STEM Robotics Program. We believe that our program is "real and relevant," filled with meaningful activities that provide students with the skills necessary to be college and career-ready. The program is an authentic hands-on learning experience that is multidisciplinary and collaborative.

Running a robotics classroom can seem like an overwhelming task. However, our Classroom Logistic Suggestions and Checklist Document will help to ease the management and organization of your classroom. Whether you are a teacher or an activity or program director running an out-of-school program, you'll find the support you need for being effective and efficient educators.

All classrooms are unique with will have advantages and disadvantages. Please take these as suggestions and make adjustments to meet your individual classroom and equipment needs.

1. Computers and Software
    - For best results, each robot/team of (2-4) students should have one computer.
    - If additional computers are available, using two computers per team will allow the teams to run the Programming Software on one computer, and view the lesson challenges on the other. If needed, they can be used together on one computer, but this separation makes it easier to see both at the same time.
    - Computers must meet the minimum system requirements for both the NXT Programming or ROBOTC Software (see Programming Software packaging for details) and the iCarnegie Learning Management System (LMS). The software package will depend on the specific course. Below is a list of the iCarnegie STEM Robotics courses:
        - Introduction to NXT Programming
        - Advanced NXT Programming
        - Introduction to Natural Language Programming
        - Advanced Natural Language Programming
        - Introduction to ROBOTC Programming
        - Advanced ROBOTC Programming
2. Batteries and Power Management
    - The 9797 Base Set includes one rechargeable Lithium-Ion ("Li-Ion") battery. However, its use is optional, and a charger may not be included by default.
    - You may choose not to use the rechargeable Lithium-Ion battery, and use six AA batteries per robot instead. You will have to either replace or recharge the AA batteries when they lose their charge.
    - You may purchase chargers for the Li- Ion NXT battery from your LEGO Education distributor, or you may already have a compatible AC adapter/charger from a previous LEGO product. **Check the voltage specifications for the adapter before attempting to use it with the NXT rechargeable battery!**

    - Use of the rechargeable Lithium-Ion battery is recommended for several reasons:
        - The NXT Li-Ion battery can typically be used (under normal conditions) for an entire school day without recharging. Lower-capacity AA batteries may not last as long.
        - The Li-Ion battery will generally provide the same amount of power to the NXT motors the whole time until they run out of power. Typical alkaline batteries will provide more power when they are fresh, and provide less and less power as they run down – this will contribute to inconsistent robot movement over the course of the battery's life. For many robot navigation challenges,

consistent movement is crucial, and the inconsistency of alkaline battery power can become a frustrating obstacle.
- One charger for each battery is recommended, as you can simply plug them all in to charge overnight.
- The batteries will monitor their own power levels and prevent overcharging.
- You may require the use of power strips to have enough plugs for all the chargers, depending on the layout of your room and the number of robots you have.
- Check with your facilities manager or custodian to make sure that your room is able to handle the electrical current needed to charge multiple batteries simultaneously.

3. Sharing Resource Sets and Modifying Robots
   - All lessons are based on the use of the LEGO MINDSTORMS robots (although you may use other robots). The MINDSTORMS robot kit contains enough parts and connectors so that you can build multiple robots from the exact same kit, although you will need multiple power packs to run them at the same time.
   - Each model takes between 20 minutes and 2 hours to build, depending on the experience level of the builder. You will need to build this time into your schedule or have students come in during their off time (lunch, before or after school).
   - All courses use the REM Bot, except the 11th & 12th grade Multi-Robot Programming and Embedded Systems and the Capstone course, which will require a different robot.
   - Robot Logistics
     - Each student team will need one robot.
     - Once built, the robot base will generally not undergo any major modifications. However, students should be encouraged to be creative with their thinking and use innovation in their design.
   - As sensors are introduced, various sensor attachments will be built and added to the base model.
     - Instructions are provided for these attachments in the lessons that use them, and in the Building Instructions section of each lesson.
     - Attachments can be built in a short time, so this task can be done in class if desired.
     - The attachments need to be built only once. If you have multiple class periods that share the robots, this means that only one class will need to build them.
     - Some educational theory suggests that the act of building the attachments may lead to a better understanding of how the robot works. You may want to spread around the opportunities for different class periods to build the different sensor attachments.
   - Some activities will require minor modifications to the robot base.
     - Remind students to return the robot to its original configuration before leaving class; otherwise later class periods will start with robots that are not correctly configured for the beginning of the activity.
   - Advanced activities will require significant modifications to the robot. This will require a different allocation of the robot resources.
     - Multi-day challenges work best when students can change various physical aspects of the robots.
     - This will cause conflicts between different class periods which must share the same robots. Teams should remove all attachments and newly made modifications to the robots after each session.
4. Classroom / Practice Area
   - The practice area space should be large enough to accommodate all the student teams, computers, practice tables/course mats, storage area for robots and other equipment.
   - Parts must be kept stored, organized and easily accessible for student teams. You may consider options such as portable storage carts or other portable organizers, cabinets, plastic storage containers that are

stackable, boxes, caddies, etc. You can check at local hardware stores or online for additional information.

5. Practice Tables / Course Mats
    - You will need to construct some type of challenge table, mat, board or designated area on the floor to "run" the robot on. The area must be flat and smooth and a minimum of 1.2 meters x 1.2 meters. Some challenges will require specific sizes, shapes and walls. Specific requirements for each course will be located with the Theme Related materials. Figures 1 and 2 below are two sample table boards.

Figure 1: 1.2 M x 1. 2 M board with side walls

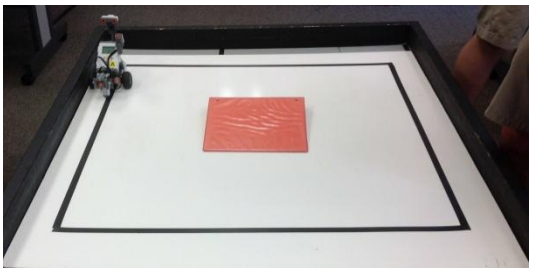

Figure 2: 1.2 M x 2.4 M board with side walls

    - Many options are available for you to create courses, depending upon resources and storage. A variety of materials can be used to construct the boards.
        a. Check hardware stores for smooth white board of plywood. Side walls can be made from 5 cm x 10 cm boards. You may choose to add legs to your board if you have room to keep them up. Otherwise the board can be used on a table top or the floor and then stores standing upright.
        b. Poster board or large sheets of construction paper can be taped together to create a course and sides can be created by using 5 cm x 10 cm boards.
        c. Plastic chair mats or other heavy duty plastic can be used with 5 cm x 10 cm boards for walls.
        d. The classroom floor can also be use and the side wall added as boards or any other material that will serve the same purpose.
        e. You can also search online for Lego robotic mats. However, the mats do not come with side walls.
        f. If your area has a First Lego League or similar organization, these are a great source of additional game board challenges. Many veteran teams will have their old mats rolled up in a corner, and some competition venues give them away (or sell them cheap) after the competitions.
    - Black electrical tape or a similar type of tape can be used to create the course/pathways. Some course modules will require additional materials to be used as obstacles or for sensing purposes. For example, lamps are often used along the pathway with the temperature sensor.
6. Student Teams
    - All robotics activities are designed to be completed by teams of 2-4 students. Teamwork is a crucial skill in the modern workplace, and the challenges of the Robotics activities lend themselves to group solutions. Quizzes, Engineering Journals and exercise portions of worksheets are exceptions to this rule. They are designed to be done by individual students for assessment purposes.
    - Each course has an Introduction to Theme Module that includes the following resources:

- Message from the CEO
- Project Summary
- Teams, Roles and Responsibilities

- Each course has a Teaming Activities Module that will help students learn to work together to practice communicating in a collaborative team activity.
- Students should be formed into teams of 2 or 4. There are 4 designated roles with specific responsibilities for the completion of student challenges. If a team has only 3 students, the last role/job can be shared. If there are 5 students on a team, 2 can share a role/job, but this can often lead to problems with one student being left out and not doing anything. Groups larger than 4 are generally too large for all the students to have a critical team role. Groups of 2 can be combined to form a single team of 4 students.
- Students should rotate roles and responsibilities throughout the year.
- It is highly recommended that you reassign students to new teams several times throughout the year. This will allow for a more diverse learning experience.

7. Structure and Pacing of a Lesson
   - Refer to the Pacing Guide / Syllabus Document for a detailed sequential timeline of learning which includes: module topic, description, objectives and session times.
   - Modules usually come with a multimedia slideshow that helps guide the student through the unit.
   - Class discussion is appropriate and encouraged whenever students have questions or issues that are relevant to the activity or subject. The role of the teacher in such discussion is not to judge, but to facilitate productive discussion. When needed, guide students toward the right answer by asking questions that will open avenues of discussion toward a successful outcome. See the Learner Centered Classroom Document for additional information.
   - Students often learn at different paces within a team. You will need to pay attention to participation and determine if all students are active, up to date with information and contributing within their teams. It is just as detrimental to a student's learning for one individual to do all the work, as it is for a student to be idle.
   - Most, if not all, modules follow the same lesson structure in the Teacher Notes Document.
     - Overview summary of the module
     - Student learning objectives
     - List of required resources
     - Approximate session time for each part of the module (one session is 45 minutes)
     - Real-world application that connects learning to everyday life
     - Additional content followed by the Student Challenge
     - Additional activities in the form of "Enhancements" for teams that finish early or students working at an accelerated pace.
     - Additional resources for teachers
     - References
   - Engineering Journals
8. Support and Assistants
   - Encourage students to both give and seek assistance from other teams in appropriate ways. There is much to be gained for all involved when one group of students helps another group to understand a concept that was holding them back.
     - The group that did the explaining reinforces its own knowledge and gains a sense of pride in their accomplishment.
     - The group that received assistance is no longer stuck.
     - The instructor did not have to spend as much time working with the stuck group, and instead had that time available to help another group who might have been having problems.
   - Helping is not the same as sharing answers.

- Someone providing assistance should not simply give the solution to the person or group they are helping. Simply giving answers does not help the receiving group to understand the concept any better, and constitutes a form of academic dishonesty.
- Discussing a concept, clarifying directions, checking calculations, comparing programs, and critiquing an approach or argument are all great ways to build understanding and solve problems that do not involve giving answers.

- Sometimes a group will come up with a particularly innovative or effective way to solve a problem. Allowing the group to share their findings with the class will both allow them to take pride in their accomplishment and help the class to work better. This is similar to the function of professors giving seminars at the university level.