Robotics: Term 1 Objectives

Notes: These standards are evolving based on what appear to be reasonable goals in a class of beginner students. They are intended to improve with time. Please feel free to share your feedback about what did or did not work in your classroom.

As a *FIRST* (**F**or **I**nspiration and **R**ecognition of **S**cience and **T**echnology) FRC team, we are passionate supporters of all *FIRST* teams. While this Teacher's Resources Page is intended as a stand-alone curriculum resource for teachers who would like to incorporate robotics in the classroom, we highly encourage participation in an FLL (*FIRST* **L**EGO® **L**eague) program. FLL Competitions make use of robots constructed with LEGO® pieces and the NXT brick. For more information on starting an FLL team, visit the FLL link on our website, or contact us directly at FLLHelp@LiveWireRobotics.com.

As always, some students excel and some students struggle. Be ready to differentiate for both ends of the spectrum.

Standard 1: The World of Robotics

Students will be able to define the terms robot and robotics.

Robot - a machine capable of carrying out a complex series of actions automatically, usually programmed by a computer
Robotics - branch of technology that deals with the design, construction, operation and application of robots

Brainstorm with students about robots they have seen or heard of previously. ***FILE INCLUDED: (ROBOT EXAMPLES)***

Robot Wow!!!: With younger students (anywhere below 6th grade) this is a great way to get them excited and it usually suits their energy levels. Each student gets a laminated picture with a short description of a robot. They read the card and then share the picture and general idea of the robot with the class. Then the teacher says, "And everybody says…" cue appropriately dramatic hand gesture and the kids chorus "Wow!!!!" It works great and keeps them engaged as 20 kids each get to share one by one. ***FILE INCLUDED: (ROBOT EXAMPLES)***

Students will be able to use the terms application, design, operation and construction to describe a robot.

Application - what the robot does (how it is applied)
Design - big picture ideas to keep in mind as you're building the robot
Operation - how the robot is operated or instructed (autonomous, semi-autonomous or teleoperated)

Play 20 Questions with students: Based on the robots you have discussed with students, allow them a certain number of application questions, design questions, operation questions and construction questions. Works great with 6th grade and older.

Does Your Robot… : Hand each student a Robot Picture Card (preferably laminated to help with survival) and have them read. Then split the group by something about the robot (examples: is it a humanoid shape, does it look like something YOU could use, does it have wheels, would you find it in your house, etc.). Everybody switches Picture Cards and you repeat. ***FILE INCLUDED: (ROBOT EXAMPLES)***

Classification of Descriptors: Have students sort classifier strips into piles of descriptors for Application, Design, Operation, or Construction of a robot. Some ideas may be new so circulating and discussing different terms with them will be very important for this activity. ***FILE INCLUDED: (Classification Activity)***

Students will be able to describe the application, operation, and design of numerous different types of robots.
Students will be comfortable with the terms autonomous and teleoperated.
Students will be able to classify a robot's operation as autonomous, semi-autonomous, or teleoperated.

Autonomous - able to act independently
Semi-autonomous - acts independently but requires some instruction
Teleoperated - requires constant instruction

Robot Inspection: Note, any actual robot examples you can have drastically improves this activity. Next best is watching short videos of each robot. As a last resort, the pictures can be printed (laminating is recommended) and passed around the room. ***FILE INCLUDED: (ROBOT INSPECTION WORKSHEET) AND (ROBOT EXAMPLES)***

Students will be able to define input and output.
Students will be able to define and assess the abilities of different sensors.
Students will understand that many tasks may be approached with numerous different sensors.

Sensor Assessment: Using the same bank of robots that you used previously (whether physical examples, videos, or pictures) have students evaluate what sensors would be most useful. The PowerPoint has short descriptors of sensors and an assortment of pictures of different robots to encourage brainstorming. ***FILES INCLUDED: (SENSOR LIST) AND (SENSORS)***

Standard 2: Using LEGO® NXTs and the MINDSTORMS Software

Students will know the function of the NXT brick (also known as the brain).

NXT 101: Point out the USB cable port, the motors, brick, cables, sensor input (ports 1 thru 4) and motor output connections (ports A, B, C).

Students will understand how to use the View Feature on an NXT.
Students will be able to collect and use data from each sensor.
Students will understand the abilities and limitation of each sensor.

NXT Stations: Introduce the View Feature of the NXT. I've found it's incredibly helpful if students know how to measure using their sensors. Set up stations around the room that students will visit to measure distances between points (rotations and degrees), ambient light (dark areas and windows), reflected light (different colors and textures), the level of sound in the room, etc. This helps them to see the limitations and abilities of NXT sensors as well. ***SAMPLE FILE INCLUDED - But Plan to Adapt for Your Classroom (Stations for NXT View Feature)***

Students will know the basics of MINDSTORSMS
Students will be able to open the program and create a new file.
Students will be able to download a program to the NXT.
Students will be able to use the Move Block and all related modifiers.

MINDSTORMS 101: Introduce MINDSTORMS, how to open and save files (the Browse to Save is confusing for the younger students), etc. Work through simple commands to get the robot move and have students download.

MINDSTORMS Icons Handout: Students can go through and label what each region of the Block indicates. Students have really struggled with reading all the information from these that is possible. I've found that having them walk through and label slowly helps. Afterwards, laminating the neatly labeled ones and using as a class resource is very convenient! ***FILE INCLUDED: (MINDSTORMS Icons Worksheet and Handout)***

Students will be able to navigate the different tabs.
Students will be able to use the Wait For command, including time and sensor modifiers.

MINDSTORMS Icons:

Using MINDSTORMS: I recommend short tasks that students repeat or repeat in a modified way. For example, after demonstrating how to insert the Move block, have students each insert a Move block with a different power, port, duration, etc. When possible, giving a set of tasks on a projector that students have to replicate works well for learning the Blocks. ***SAMPLE FILE INCLUDED: (Short Challenges)***

Students will be able to program using all four NXT sensors (touch, light, ultrasonic and sound)
Students will be able to write a program that includes a loop command.

Programming Relay Race: With students working in small groups it becomes very easy for one student to become the lead programmer while other students don't practice basic skills. I've found Relay Races to be very effective means of ensuring that each student participates. Design a set of simple tasks and arrange the steps such that each student accomplishes a variety of different tasks. In the sample, I had students work in groups of 3, so I color-coded my instructions to make sure that each student would add a Move Block, modify the power, etc. ***SAMPLE FILE INCLUDED: (Move Relay Race)***

Simon Says / Touch Sensor: Have students program a robot that 1) Waits for the touch sensor to be pressed, 2) Runs motors for unlimited until, 3) Waits for the touch sensor to be released then, 4) Stops. This series of 4 commands is easy to test and students run the program over and over which makes for an excellent platform to introduce the Loop Command. Have students put an unlimited loop around this sequence of four commands. Then play SIMON SAYS. Students love it!

Robo-Pet / Ultrasonic Sensor: Have students program a robot that 1) Drives forward until an object is less than 10 inches, 2) Stop, 3) Repeat with a loop. Use this as an illustration of how you could create the illusion that your robot was following you like a pet.

Students will become familiar with basic commands in MINDSTORM.
Students will be able to navigate the MINDSTORMS software and comfortable with all modifiers in the common palette.
Students will be able to program a robot for a series of very accurate turns and measurements.

Tile or Box Challenge: Have students program their robot, using only motor rotations, to travel around a box and return to their starting position. This forces them to have clean turns and accurate distances.

Path Challenge: This is great if you have tile floors as they can create the pattern anywhere, otherwise, tape is your friend. Create a pattern that the students must program their robots to follow. For example, travel one tile forward, turn right, travel two tiles forward, turn left, travel one half tile, turn right and travel one half tile. Integer multiples allow them to see that doubling or halving their measurements is useful (to a point).

Standard 3: Building with LEGO®

Students will be able to follow basic directions for construction.
Students will gain building experience.

LaikaBot: Have students follow instructions for a simple robot. As a general rule, I don't like telling them how they have to build something, but this keeps construction focused. Warning: as soon as LEGOS® are out, you will lose some students to "play time" mentality, so the more structure you can build into the class before that happens - the better off you are! ***FILE ATTACHED: (LAIKABOT)***

One of These Things is Not Like the Others: After construction, line all the robots up and discuss differences. Some students have never worked with LEGOS® before and may need to be told it's a good idea to click the pieces together well, etc. Afterwards, give students time to make adjustments to their robots.

LaikaBot Assessment: Each student writes down three strengths (easy to build, simple, sturdy, etc.) and three weaknesses (doesn't turn well, boring, etc.) and explains their opinion as to why it's an important strength or weakness. Also, have students draw a simple diagram to label motors, ports, show the design, etc. Students struggle with diagrams and using as follow-up with building tasks ties it in nicely.

Students will be able to use gears to reverse rotation direction and modify speed relative to motor rotation.

Arm Challenge: Have students build an arm that opens and closes with one motor. Encourage the use of gears to facilitate one motor making pieces move in opposite directions. Note: I didn't try this task with grades below 10th.

Students will be able to assess design strengths and weaknesses in robots they have built.
Students will be able communicate step-by-step instructions to build something they have created.
Students will be able to share their designs with others.

Building Challenge: Have each student (or a small group of students) design a simple robot and create step-by-step instructions for another student to follow. Step-by-step instructions should include pictures, brief descriptions, etc.

Students will be able to design and build a robot capable of carrying out a set of specific tasks.

Game Challenge: Games are my favorite way of challenging students to apply their knowledge. Make up a game that involves moving pieces on the field, make game pieces out of LEGOS®, mark the field with tape and turn them loose. If they conquer it quickly, make up a more challenging game for next time. If you are juggling multiple sections that share kits, have each class build separate attachments that they add and remove for each class. In that situation, I recommend tracking "robot maintenance" so you can speak with students or dock points if they do not leave their robot in working order for the next class. ***FILE ATTACHED (NXT GAMES)***

Standard 4: Innovative Problem Solving

Students will evaluate and assess different strategies for solving a problem.
Students will understand that many tasks may be approached with numerous different solutions.
Students will be able to design and build a robot capable of carrying out a set of specific tasks.

Game Challenge: Again, games are a fantastic way of forcing them to problem solve and think through different options! ***FILE ATTACHED (NXT GAMES)***