Introduction to Mobile Robotics 3-Week Immersion Unit

Goal: Introduce students to:

- Programming mobile robots
- Sensors, thresholds, and feedback
- Appling measurement and geometry to calculate robot navigation
- Experimental process
- Documentation

Resources:
1 NXT kit for every two students.
1 prebuilt robot for each pair of students, preferably Taskbot, but the Robotic Educator model will work.
1 USB cable to upload programs to the robot.
1 computer for every two students.
1 copy of the LEGO® MINDSTORMS® Edu NXT programming software.
1 copy of Introduction to Mobile Robotics curriculum installed on each computer.
Either the NXT battery pack or 6 AA batteries for every robot.

Note to the Teacher
With a three-week segment of time, assuming that the teacher will devote one period per day to robotics, students will learn basic programming and navigation of the NXT robot. Students will be involved in two lessons that teach and reinforce measurement and geometry. In week three, students will begin learning about sensors. The teacher can find detailed descriptions about each lesson on the Teacher CD under Projects, including the answers to all worksheets and quizzes.

Typically, each pair of lessons takes approximately one week to implement. As students become familiar with the programming environment, the NXT hardware, and the curriculum they may move a little faster based on ability and motivation. Do not allow the students to go through the lessons haphazardly. Require them to document their work and complete all exercises. It is important that students do not skip the applied mathematics in the *Wheels and Distance* and *Measured Turns Investigations*. These lessons are critical to their understanding of future lessons. The Sound Sensor is introduced in week three. The Sound Sensor lesson begins with a general presentation on sensors found on the Teacher CD, which includes the concept of a "threshold." Students will need to obtain a clear understanding of what a threshold is because that concept will be used over and over as they explore how sensors work.

There are six major activity sequences in this three-week unit:

- The *Full Speed Ahead Activity* guides students step-by-step through the process of setting up the programming environment, programming the robot, and running the basic moving forward program.
- The *Wheels and Distance Investigation* involves students in an investigation of the relationship between wheel size and the distance the robot travels given a set number of wheel rotations.
- The *Right Face Activity* guides students through the process of building two different programs, each of which produces a different type of turn.
- The *Measured Turns Investigation*, which involves students in an investigation of the relationship between robot geometry, motor degrees, and the amount the robot turns.

- The *Clap On, Clap Off Activity* introduces students to sensors, specifically the sound sensor. Students are led step-by-step through the process of finding a threshold, programming the robot, and running through several programs that rely on the sound sensor to control their robots behavior.
- The *Frequency and Amplitude Exploration* involves students in an investigation of the properties of a sound wave, and which properties of the sound wave that the sound sensor is able to distinguish.

Anytime Activities

In a three week time period, some students will move faster than other students, the "Anytime Activities" are designed to challenge advanced students while other students complete their work. The following anytime activities can be implemented:

- *Hello! My Name Is…* - Not all robots work alone. Sometimes the have to interact with a human or human operator in order to perform their task. To make it easier and more pleasant for the human to understand what the robot needs, robot designers give their robots personalities using sounds and display options. Here, students will do the same with their Personal Assistant robots.
- *Full Stop* - No matter how well you design your robot, sometimes things just don't go as planned. In this activity, students will design and program an emergency stop button for their robot, to make sure it can be controlled if it gets out of hand.
- *Ramp It Up* - The robot won't be able to climb stairs, but it should be able to take advantage of a ramp if it can find one. In this Activity, students will explore the physical features of the robot that make it tip or be stable on a ramp. This includes a discussion of Center of Mass and support polygons.

Teacher References

In the Projects section of the Teacher CD, you will find the following teacher tools to help you implement this lesson:

- Teacher Notes and Concepts PDF
  - A description of the Activity
  - What the students will do
  - A note to the teacher describing the rationale for the lesson
  - What the student will be able to do by the end of the lesson
- A Lesson Starter Powerpoint, which is editable, that can be used as an anticipatory set that sets the stage for the lesson.
- Question & Answer Keys
  - Student worksheet for the lesson
  - Worksheet answer key
  - Student quiz
  - Quiz answer key