Lesson Title   Robot Line Tracking
Length of Lesson   2 Days
Created By   Dustin Spayde
Subject   Robotics
Grade Level   11-12
State Standards
DOK Level   DOK 4
DOK Application   Design, Create, Apply Concepts, Analyze,
                                                Critique, Connect
National Standards   9-12: A(Inquiry), E (technology)
Graduate Research Element   Developing Automated Systems

Student Learning Goal:

National Science Education Standards of Content 9-12
A (Inquiry): Identify questions and concepts that guide scientific investigations.
E (Science and Technology): Abilities of technological design: propose designs and
choose between possible solutions, implement a proposed solution, evaluate the solution
and its consequences, communicate the problem, process, and solution; Understanding
about science and technology

Materials Needed (supplies, hand-outs, resources): A Lego Mindstoms NXT kit per 2-
3 students, one extra NXT light sensor per group, Access to computers (one for each
group) with USB ports and the Lego Mindstorms NXT software (or other compatible
language) installed on each, black tape, green tape, and at least 6 2'x2' squares of foam
board.

Lesson Performance Task/Assessment:
Each team will demonstrate their final program, which should enable their robot to
navigate the line tracking course.

Lesson Relevance to Performance Task and Students:
An automated vehicle such as this could easy be found in many factories and ports
around the world. Developing its navigation system is an applicable task for a many
engineering fields.

Anticipatory Set/Capture Interest:
Have a few students assemble a course from a few of the panels and have the instructor's
robot complete the course.

Guided Practice:
Day One: Students will modify the base model of the NXT robot to carry two light sensors (in the front of the vehicle, side by side). Students will then be presented with multiple line tracking course panels. The students must design a program that allows the robot to successfully follow the lines on the panels not matter which order the panels are placed. (Example course panels can be found at http://www.robocupjunior.org.au/node/53. These examples are also included in the teacher notes section)

Day Two: Each team will run the final course until they have completed it successfully. (Some important questions to ask during this time are; "What are the limitations of your design?", "What would happen if the layout of the course changed?", "Would your robot still function properly without going off course? Why or why not?", "How could you improve your design?")

Independent Practice:
Students will be presented with the set of line course panels that will be used to construct a random course. Students are then split into design teams. Each team is tasked with designing a program that allows the vehicle to complete the course by following the black line. Teams will then test run the course in front of the instructor to be marked as completed.

Remediation and/or Enrichment:
Remediation: individual IEP; partner help throughout lesson; shorten parts of assignment; focus upon smaller elements of the process

Enrichment/Extension:
 Set up a seminar in which students explain the design of their programs to the rest of the class.

Check(s) for Understanding:

Day One: Have all teams designed to follow a solid line?

Day Two: Have all teams completed their designs to navigate the course?

Overall: "What are the limitations of your design?", "What would happen if the layout of the course changed?", "Would your robot still function properly without going off course? Why or why not?", "How could you improve your design?"

Closure:

Day One: Allow the students to work as long as possible, while the instructor browses each group's work to clarify any misconceptions. Finish by informing the students to save their work a being prepared to finish their programming during the next class period. Encourage them to design for the next period outside of the classroom.

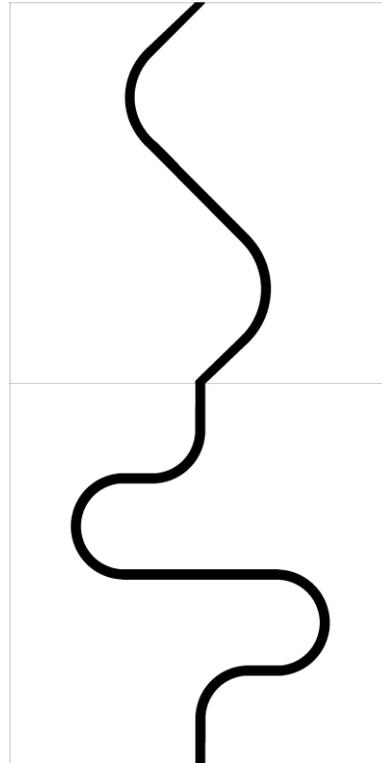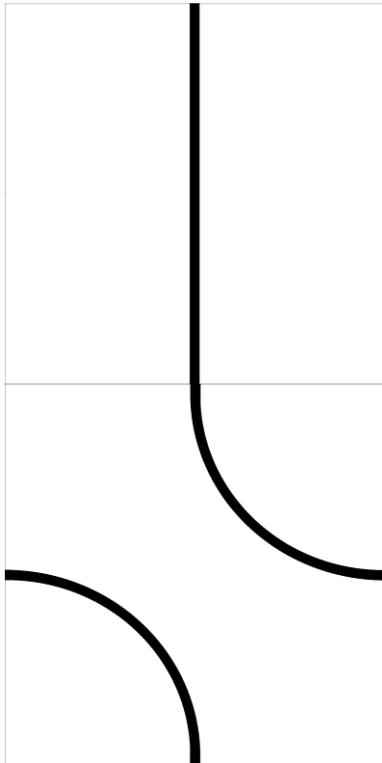Day Two: Discuss with the class which team did the best and why.
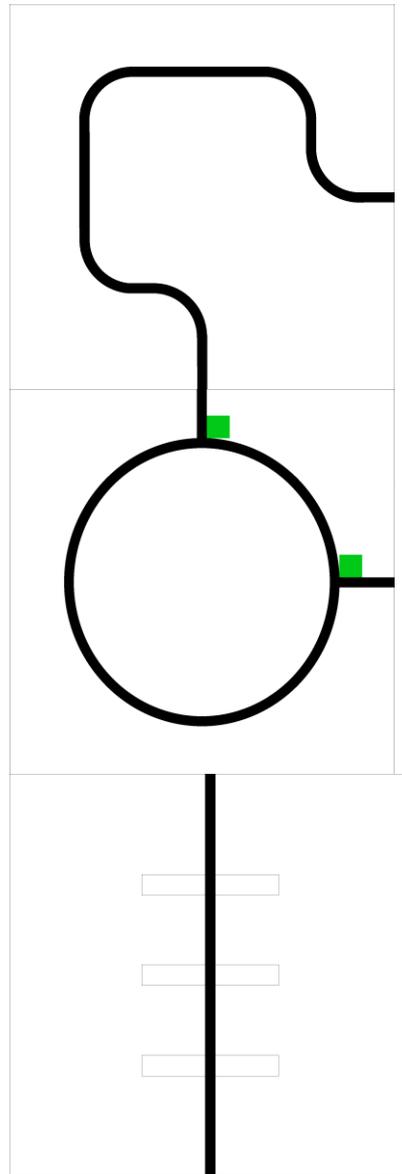
Possible Alternate Subject Integrations:

*Math – can manipulate mathematical expressions to isolate needed variables

*Programming – Basic logic and algorithm models
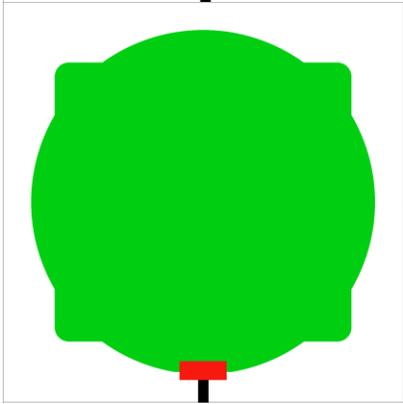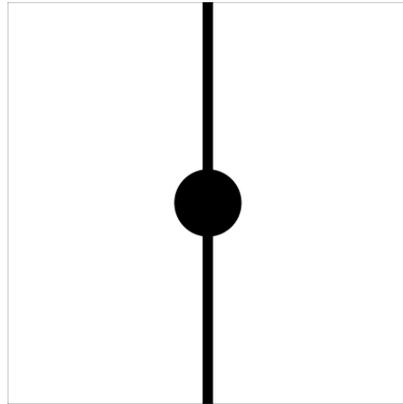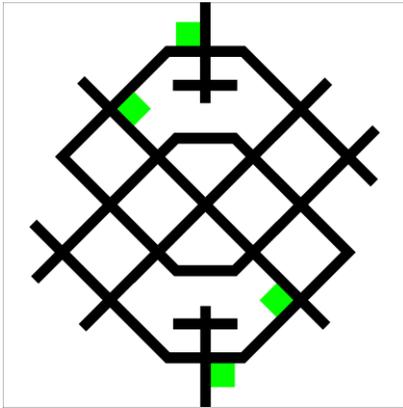
Teacher Notes:

All templates from www.robocupjunior.org.au
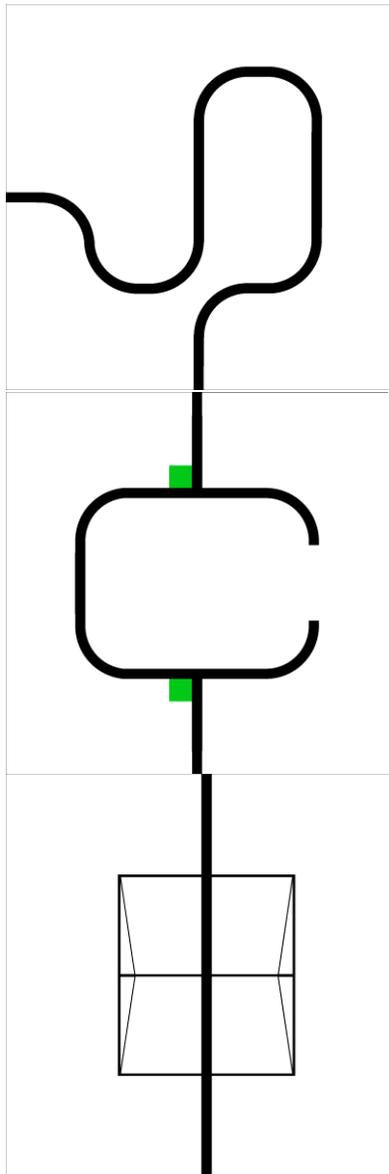
Green Tape is used to signify shortcuts
In the tiles directly above the left contains a ramp, while in the right 6 rectangles have
been removed from the foam board to create speed bumps.

End Tile