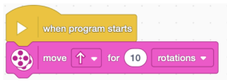
INTRO TO PROGRAMMING CURRICULUM - ADVANCED

OVERVIEW:

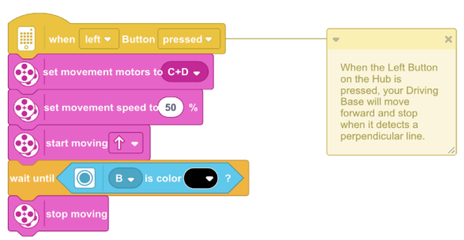
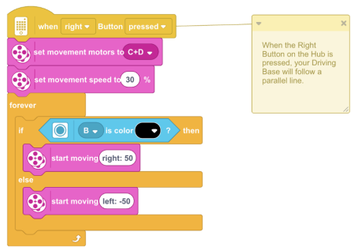
Total # of sessions	Program Aims. "By the end of the semester..."	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9	Lesson 10	Lesson 11	Lesson 12	Lesson 13	Lesson 14
14	By the end of the semester, kids should be able to: - Problem solved as a team to figure out how to build attachments - Do basic programming to complete a simple mission (or series of missions) - Have confidence in what they can do.	- Work in teams on several non-robot challenges (Six Bricks) - Log into the SPIKE Prime app and computers - Work through series of 3 programming challenges until they reach a concept they haven't seen before (to sort into beginner and intermediate) - Can you load any program onto the robot - Can you get the robot to drive in a straight line - Can you draw a square	- Learn how to program turns and use loops - Motor recognition - Create a program to drive in a square EXTENSION - Work on making different shapes - Hexagon, triangle, square	- Work on making different shapes - Hexagon, triangle, square EXTENSION - Draw a star!! - Can you write a general formula for drawing any polygon?	- Start relay race of pushing blocks - Focus on programming turns and using loops EXTENSION - Add obstacles to the field	- Keep pushing bricks in field - Add obstacles to create programming challenges EXTENSION - Try to run drills with obstacles and your robot, how complex can you get?	- Go through a maze! - Focus on entering at the same spot and turn precisely EXTENSION - Add obstacles to the field	- Add obstacles in the maze - Have them try to complete three laps inside maze (using loops) EXTENSION - Can you draw a shape while avoiding obstacles inside the maze?	- Introduction to distance sensors - Use distance sensors to address obstacles without having to program lengths EXTENSION - How quickly can you get through the maze?	- Introduction to line following (using one colour) - Move forward until black tape detected EXTENSION - Can you use the tape to draw a shape?	- Introduction to (guided) building of attachments - Create attachments to hold LEGO brick EXTENSION - Design an attachment that can hold multiple bricks!	- Go through simple obstacle course to deposit the bricks you have carried EXTENSION - How might you incorporate loops? How many bricks can you deposit in 2 minutes?	- Bring out one SIMPLE mission model for students to work with - Build attachments for that model EXTENSION - Start to program that path	- Program and run paths with that model! - Have each student demo their run at the end EXTENSION - Try to incorporate as many new programming skills as you can into just one program!	- Pizza celebration!! - Recap what they have learned
14	By the end of the semester, kids should be able to: - Start to identify problems/challenges. - Design their own attachments - Do intermediate programming (e.g. line following, complex tasks, mechanisms that more than just push) to complete a series of missions.		- Brief review of beginner concepts: program moving robots in a square and triangle using loops and turns - Line following in-depth review and work time EXTENSION: - Work through problem set of line-following tasks that are more complex	- Designing attachments workshop - Making marker attachments for drawing EXTENSION: - Create an extension that can hold three pens separate from each other - Create a pen extension that can be lifted up or down	- Work drawing shapes with attachments made - Mini competition for best picture by the end of session EXTENSION: - Draw a self-portrait with the pens!	- Review of distance sensor program - Building claw attachments for relay races! (HERE) EXTENSION: - Try to build an extension that can pick up as many blocks as possible in one run!	- Compete in a relay race! - Add more obstacles to challenge students EXTENSION: - Try to build an extension that can pick up as many blocks as possible in one run!	- Line following review and deepen, multiple colours and with obstacle course/harder elements - Use this session to fill in any programming gaps appearing EXTENSION: - Add interactive elements to the obstacle course they have to move/pick up to	- Football game with line following! - Work on applying skills of turning and line following to push balls into goals EXTENSION: - Find a partner and try to see how many passes you can get between each other - Try to shoot	- Merge line following and distance sensor programs to challenge students - Create an obstacle course that combines both skills EXTENSION: - Add custom attachments to interact with the obstacle course - See how short you can make	- Introduce a mission model from previous years - Guide them through building an attachment for the model - Program the "run" for that model EXTENSION: - Try out a few different model runs!	- Bring out several mission models and have students choose a model to work on, designing their own attachments and programming runs EXTENSION: - Try a multi-model run	- Introduce multi-model runs, allowing students to test their programming and design abilities EXTENSION: - Try a multi-model run with only ONE attachment! Design carefully	- Final work day for programming complex runs - Test out each group! EXTENSION: - Try a multi-model run with only ONE attachment! Design carefully	

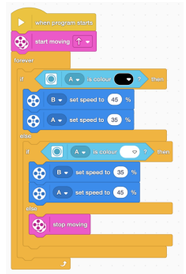
								continue!	penalty kicks! See how far away you can get the ball in	your code and still make it to the end!					

DAY ONE

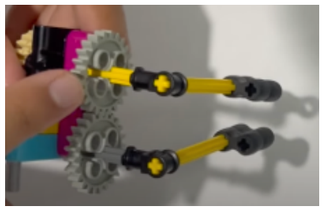
Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Read through the Six Bricks Problems (HERE) - Refresh yourself on the SPIKE Prime app functions (how to log in, what the interface looks like, etc) - Look at the example code snippets listed in the mentor help column - Remind yourself how to load a program onto the SPIKE Prime robot	Six LEGO Bricks per group (bring extra just in case), one computer per group, SPIKE Prime robots, SPIKE Prime app on computer	- Mentor Introductions (~5 min) - Six Bricks Challenges (~15-20 min) - Log in to the SPIKE Prime app on computers (~5-10 min) - Programming Challenge Screening (~25 min) - Challenge 1: can you load a program onto the robot (~5 min) - Challenge 2: can you make the robot drive straight forward (~10 min) - Challenge 3: can you make the robot drive a square (~10 min)	Example code (Challenge 2):  Example code (Challenge 3):  Avoid helping kids too much today because the goal is to test their skills

DAY TWO

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Read through the lesson plan this is modeled off of on the SPIKE Prime website (HERE) - Familiarize yourself with either the answer key program or other examples of line-following - View a video to review continuous line following principles (different values to how we teach but same idea) (HERE) - Instructions for building color sensors (HERE) - Print line following paper from the SPIKE Prime website (HERE) OR draw a thick black line on white paper with Sharpie	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, color sensors for each group, line following paper	- Review of beginner intro concepts (~15 min) - Make the robot move in a triangle using loops and turns! (~7 min) - Make the robot move in a pentagon (five sides) using loops and turns! (~7 min) - Add color sensor onto drive base in groups (~10 min) - Explain what color sensors do - Discussion (~5 min) - Let students explore programming with color sensors! (~30 min) - Challenge 1: drive until you reach a black perpendicular line, then stop (~10 min) - Challenge 2: try to drive parallel/on top of black line (~10 min) - Challenge 3: try to follow a line continuously (~10 min)	Same as the Day 1 square program but with different angles and number of repetitions (3 turns at 120 degrees for a triangle and five turns at 72 degrees for a pentagon) Challenge 1:  Challenge 2:  Challenge 3:

DAY THREE

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Watch videos to get a sense of how students might go about the challenge (HERE) - Review the steps of the design process	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, LEGO bricks and other spare parts for students to design attachments (reference images in mentor help section for ideal parts to bring along), pens for each group	- Define the design process - Simplified (~15 min) - Define - Identify the problem you want to solve (attaching the pens to the robot) - Ideate - Brainstorm a couple of different ways to solve that problem - Prototype - Build these attachments with the LEGO bricks you have and see how they work! - Improve - Take the designs you have and tweak them for even better results - Work time on building attachments (~45 min) - Check-in every 10-15 minutes to ensure groups are on track with each step	If students are stuck, direct them to parts like the ones that are below to help them get started - Remember there is no right way to design  

DAY FOUR

Preparation	**Resources Required**	**Activities + Timing**	**Tips/Mentor Help**
- Brainstorm some fun ideas for drawings to make if students get stuck	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, attachments made last time, paper and pens for each group (lay papers out together to give more space for drawings, extra paper (if needed)	- Work time on drawing shapes using pen attachments made last time (~15-20 min) - Picture drawing competition work time (~30 minutes) - Gallery walk-through of different drawings (~10 minutes)	Same skills as before, just letting students get creative! Try to encourage out-of-the-box ideas and help them work independently

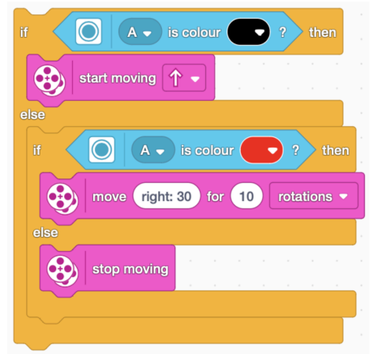
DAY FIVE

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Refresh knowledge on distance sensors through the lesson plan from SPIKE Prime or via another method (HERE) - Read through the assembly manual for claw attachment to make sure all is familiar (HERE)	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, Instructions (found HERE starting page 20), assembly manual materials, distance sensor for each group, spare bricks and other parts to encourage creative designs	- Recap what distance sensors do (~5-10 min) - Attach distance sensor to drive base (~10 min) - Build claw attachments for the relay race (~30-35 min) - Challenge students to think creatively and go beyond basic claw design - Have students make the other parts (as shown in the SPIKE Prime lesson plan) of the relay race for the next time	Encourage students to think outside the box in creating attachments.

DAY SIX

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Follow the rest of the lesson plan from last time, can reread it (HERE) - Make sure you are familiar with the example code, reference the Tips/Mentor Help section on the right	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, relay builds from last time, stacks of LEGO bricks to act as obstacles	- Programming claw attachments from last time to prepare for the relay race (~25 min) - Compete in the relay race (~15 min) - Add obstacles to relay course and offer as a challenge for students (~5-10 min)	Because there are no solutions for the challenge, encourage students to think creatively. How might they dodge 1 obstacle before stopping? Two? Example code:

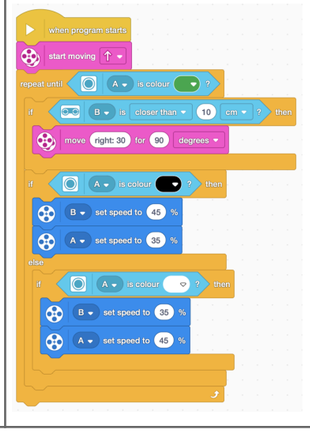
DAY SEVEN

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Review the lesson plan from LEGO for reference (has different programming work but the same general idea and initial activity) (HERE) - Make sure to familiarise yourself with color sensors, reference Tips/Mentor Help section on the right	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, four different colored LEGO bricks (red, green, yellow, blue), color sensor attachments, poster paper or four A4 pieces of paper per each group OPTIONAL: whiteboard to write "commands" on for students to follow	- Brick color activity with discussion (~15 min) - Hold up different colored bricks with actions assigned to each (ie. jump when you see a red brick, clap when you see a blue brick, spin when you see a green brick, crouch down when you see a yellow brick, etc) - Have students follow these commands to get practical application of how color sensors work --- - Group multi-color sensor work (~35-40 min) - Have students draw out a set of lines using different colored pens on pieces of paper - Have students create a program that tells the robot to do a different action for each color - This includes attaching a color sensor to the robot again (students should be familiar after session 2) --- - Discussion about what programming skills they have learned so far (~5-10 min) - Ask about each concept they've learned so far to review and fill in any programming gaps	Example of a multi-color program:  **CONCEPTS COVERED SO FAR:** - How to turn, move, and use if/else statements and loops (review from beginner concepts) - Building and designing attachments - A recap of distance sensors (review from beginner) - Complex problem-solving - Multi-color line following

DAY EIGHT

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Review the line following code from Day 2 - Review the claw attachment build link if needed (HERE) - Prepare two football maps (one easy and one complicated)	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, claw attachments from Day 6, football map on paper (one easy, one complicated), one LEGO brick for each group to act as the ball	- Re-attach claw attachments from day 6 (~5-10 min) - Swap small white ends around to work as a brick pusher --- - Simple line following to push bricks (the footballs) into goals (~25 min) --- - Challenge line following to push bricks (the footballs) into goal (~20 min) - Map with multiple colors for different routes/positions they can take to the goal	If students are stuck, reference the previous line following answer keys No answer key, challenge students to think creatively and combine what they know

DAY NINE

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Refresh yourself on the distance sensors function from earlier sessions	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, distance sensors, any parts required to add onto robot, obstacles (could be LEGO blocks, cardboard blocks, etc), simple football field map from last time	- Install distance sensor (~5-10 min) - Color & distance sensor combo activity (~45 min) - Add obstacles to the football field from last session and have students write program using color and distance sensors to navigate and score	Review the distance sensor installation from the previous lesson if students are struggling. Encourage students to problem solve and find their own solutions. Example program below: 

DAY TEN

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Remind yourself how the AUGMENTED REALITY STATUE works (HERE) - Refresh design thinking ability or basic programming if needed	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, one AUGMENTED REALITY STATUE mission model per two groups, LEGO parts and bricks similar to those used for pen attachments	- Introduce and explain the AUGMENTED REALITY STATUE from last year's game (~10-15 min) - Describe the function and interactive element - Facilitate discussion in groups about what might be challenging about it - Build an initial attachment to interact with the lever (~25 min) - Encourage students to draw on design thinking from lesson 3 - Start programming "run" for that model (~20-25 min)	Reference prep materials to understand how the model and example attachments Push students to think themselves, don't give out answers Code will depend on the attachment built, so no clear answer key Draw on previous lessons to help students!

DAY ELEVEN

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help

- Watch a video to see an example of a successful run and the mechanism that is used to do it (HERE) - Refresh programming skills if needed	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, one SOUND MIXER mission model per two groups, spare LEGO bricks, parts similar to those seen in the preparation video for those building new attachments	- Introduce a second mission model - The SOUND MIXER (~10-15 min) - Same as last time, introduce key function and concepts then have students engage in discussion - Let groups choose to keep working on last model or this model (~40 min) - Have each group share out on what they did that day, encourage group discussion (~5 min)	Same as Day 10

DAY TWELVE

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
Thinking to yourself, how might you go about it? This will help prepare you to be working with the kids	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, both mission models from previous days, spare LEGO parts for attachments	- Explain multi-model runs (~5 min) - Help students understand being able to complete multiple models with just one set of code and one attachment - Work time on this or continue focusing on just one model (~50 minutes)	Same as Day 10

DAY THIRTEEN

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Refresh design thinking ability or basic programming if needed	One computer per group, SPIKE Prime robots, SPIKE Prime app on computer, both mission models from last time, spare LEGO bricks for attachments	- Last chance to test, program, and build to complete multi-model runs (~30 min) - Have each group demonstrate what they were able to do (~30 min) - Encourage each group to share no matter how much or little they have done	Keep encouraging each member and help them collaborate with each other

DAY FOURTEEN

Preparation	Resources Required	Activities + Timing	Tips/Mentor Help
- Think about some questions to ask students if they aren't wanting to share	Pizza	- Discussion and reflection on what we all learned (~15 min) - Pizza party and celebrate accomplishments! (~45 min)	N/A