Navigational Coding - Unplugged

Strands:	Suggested time:
Spatial Sense Algebra Social-Emotional Learning in Mathematics and the Mathematical Processes	2 x 45/50 minute periods
Topic:	**Grade:**
Using Coding to Describe Location and Movement (Unplugged)	5

Overall and Specific Expectations:

Spatial Sense

- E1. describe and represent shape, location, and movement by applying geometric properties and spatial relationships in order to navigate the world around them
  - E1.4 plot and read coordinates in the first quadrant of a Cartesian plane using various scales, and describe the translations that move a point from one coordinate to another
  - E1.5 describe and perform translations, reflections and rotations up to 180 on a grid, and predict the results of these transformations

Algebra

- C3. solve problems and create computational representations of mathematical situations using coding concepts and skills
  - C3.1 solve problems and create computational representations of mathematical situations by writing and executing code, including code that involves conditional statements and other control structures

Social-Emotional Learning (SEL) Skills in Mathematics and the Mathematical Processes

- A1. Throughout this grade, in order to promote a positive identity as a math learner, to foster well-being and the ability to learn, build resilience, and thrive, students will apply, to the best of their ability, a variety of social-emotional learning skills to support their use of the mathematical processes and their learning in connection with the expectations in the other five strands of the mathematics curriculum.

  In this lesson, to the best of their ability, students will learn to **recognize sources of stress and cope with challenges** and **build relationships and communicate effectively** as they apply the mathematical process **communicating** (express and understand mathematical thinking, and engage in mathematical arguments using everyday language, language resources as necessary, appropriate mathematical terminology, a variety of representations, and mathematical conventions) and **representing** (select and create a variety of representations of mathematical ideas (e.g., representations involving physical models, pictures, numbers, variables, graphs), and apply them to solve problems), so they can work through challenging math problems, understanding that their resourcefulness in using various strategies to respond to stress is helping them build personal resilience, and so they can work collaboratively on math problems – expressing their thinking, listening to the thinking of others, and practising inclusivity – and in that way fostering healthy relationships.

Learning Goals:	**Success Criteria:**
We are learning… ● how to create a code to represent a mathematical situation (a trip route using the coordinate plane) ● how to describe and represent shape, location, and movement (vocabulary) ● how to plot and read coordinates in a Cartesian Plane ● how to describe translations that move a point from one coordinate to another	I can…. ● produce a code to achieve a specific goal ● alter an existing code to accommodate an obstacle, using a if/then statement ● alter the terrain of a grid using various transformations and adjust the code accordingly to obtain the same overall outcome ● explain various movements executed through code by appropriately referencing exact coordinates and appropriate vocabulary to describe outcomes *Note: These success criteria are a suggestion; if time allows, co-create with students, using prompts to ensure learning goals are reflected.
Prior Learning:	**Resources and Materials:**

Students should be familiar with the Cartesian Plane, finding points using the positive quadrant (alphanumeric).	Copy (copies) of Appendix A or PDF version Appendix B or PDF version Appendix C or PDF version Grid Paper (large) Markers Masking Tape  Virtual version: Location and Movement

Learning and Teaching Activities:

Starting Learning	
Whole Class (teacher prompts in italics): Draw or screen the image of a town, with various landmarks (Appendix A). Looking at this map, explain how to go from the school to the library. Ask a few students to share their routes, ensuring that there are a variety of solutions. Ask, “were there any routes that were more efficient than others? In what way were they more efficient?” Remind students that when they are walking, they rotate their own body as they change directions. As students share routes, have them record their instructions, clarifying their description. For example, if a student says “go right one square”, respond with, “where do we start?” or “do I need to rotate first?” The route description(s) should look like this (Appendix B):	**SEL:** Notice if students feel comfortable with the trial and error process, using different approaches collaboratively to problem solve the various obstacles.

<table>
<tr><td colspan="2">Begin at coordinate (A, 1)
Advance 1 square to the right (R1 or R→)
Rotate 90 degrees counterclockwise (↺90)
Advance 3 squares
Rotate 90 degrees clockwise
etc…

Highlight routes that are the most direct and the most efficient (least amount of walking, few twists and turns).</td><td rowspan="3">Diagnostic assessment:
Note the way students use vocabulary (up, down, left, right or North South East West) to describe movement.

Opportunities for Differentiation:
Students can be given a hard copy of the map to trace routes.

The map could be placed in Google Slides so students can superimpose arrows and information to indicate routes and navigate obstacles.

DPA: Students can work collaboratively to navigate the classroom instead of using grid paper.</td></tr>
<tr><td colspan="2">Active Learning</td></tr>
<tr><td>Working in pairs, students will create their own map of a town. Provide students with large pieces of graph paper (min. 20 x 20).
  Virtual version- Create Map in Google Draw

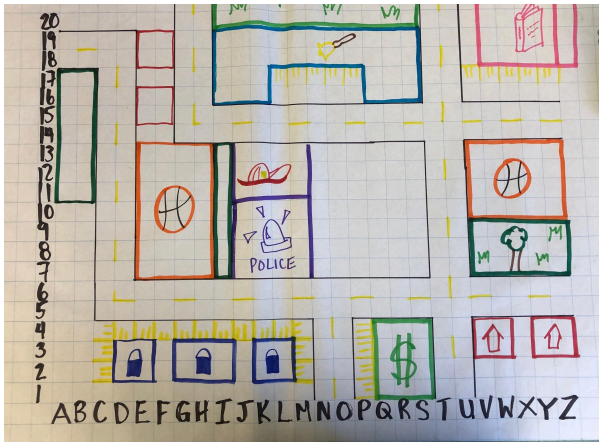
With the class, co-create a checklist for creating the town. Here is a sample:

❏ Label the axes (x,y) - using alphanumeric plot points
❏ Minimum of 3 stores located next to each other and appropriate parking
❏ At least 1 school
❏ At least 1 bank</td><td>Teacher Moves:
Encourage students to communicate clearly, making the link between oral communication and communicating instructions in written form, or coding.

Ask students how many possible routes do they foresee being successful to get from point A to point B.

Inquire if any of the students’ coding or instructions are redundant. Can they achieve the same result in fewer steps?

While pairs try out each others’ work, ask the groupings if there were any problems; which problems did they</td></tr>
</table>

❏ At least 1 library ❏ Minimum 5 residences (houses, condos or apartments) ❏ Green space ❏ At least 2 places for recreation ❏ Other places students choose  Students will choose two places on their map as point A (the start) and point B (the destination). They will then write out step-by-step instructions, using the sample from the earlier activity as a guide, as well as the template (Appendix B). PDF version Ask students to summarize the overall translation that occurred (i.e. 8R, 6U or 8→,6↑).	identify and how they could address the "bug" in their coding? Note: Students may not be able to complete their map drawings during one class, so this activity may be spread across two days.	The size of the grid and/or paper can vary, as can the expectations for the town. **Formative evaluation** - Observe the ways students work together to co-create checklists and success criteria. Do they understand the goals for the activity? Can they clearly articulate their own ideas?

Students and teacher(s) will co-create Success Criteria so that students are clear of their goals. After students have worked on their maps for some time (but they are not yet complete), have students select an obstacle, which they must integrate into their map and the directions they're providing. You can assign them one, or have them pick from Appendix C. (Photo credit for Appendix C: freesvg.org) Version PDF After maps are complete and directions have been written out, students will rotate around the room to try each others' directions using the maps. The number of directions/maps each pair tries to solve will vary according to time available.		**Summative evaluation** - Note how students have used the coding language to describe the movements. (translations, reflections, rotations)Have students met the success criteria?
Consolidation of Learning		
Gallery Walk Students will be referred back to the success criteria. Maps with directions will be displayed around the classroom. Students will be invited to write on stickies about their peers' maps and directions. Students who have been challenged to find routes can reflect on what challenges arose when navigating.		

After students have participated in the gallery walk, the teacher can gather the class again to discuss the highlights and write out the common themes (summary) that emerged during the activity.	**Summative Assessment** - How have students linked the success criteria to their peers' maps and directions?

Further Consolidation/Next Steps for students and teachers:

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Unplugged: Draw your own neighbourhood and create routes from one place to another, using street names and Cardinal Directions.

Plugged in: Explore a location using Google Maps and look at how the program shifts routes according to the vehicle used (car, transit, biking, feet - walking).

Games:
Desmos: The (Awesome) Coordinate Plane Activity
NCTM: Plotter the Penguin

Lien à la leçon française : La navigation par codage - débranché