Lesson Plan: Angles and Algorithms
Grades and Contents: 4th Grade Math

Topic: Math and Computer Science

Enduring Understanding

- 2D shapes can be described and classified based on what they look like.
- Shapes can be measured using specific tools.
- An algorithm is a series of simple steps to complete a complex task.
- Decomposition occurs when a complex task is broken up into simple tasks.
- Stay focused. Sometimes people can get so wrapped up in a task that they forget their purpose.

Standards

Math (Measurement and Data Analysis Strand)
4.MDA.6 Measure and draw angles in whole number degrees using a protractor.

Computer Science (Algorithms and Programming Strand)
Standard 4: Develop a program to express an idea or address a problem.
4.AP.4.1 Use picture directions to design a series of steps to complete a complex task.
4.AP.4.2 Test a series of directions to successfully complete a complex task.

Secondary Standards:

Math
4.G.1 Draw points, lines, line segments, rays, **angles (i.e., right, acute, obtuse)**, and parallel and perpendicular lines. Identify these in two-dimensional figures.

Computer Science
Standard 3: Explore how tasks can be decomposed into simple tasks and simple tasks can be composed to form complex tasks.
4.AP.3.1 Compose simple tasks (e.g., eating breakfast; brushing your teeth; walking to the bus stop) into a complex task (e.g., getting ready for school).
4.AP.3.2 Decompose a complex task (e.g., getting ready for school) into simple tasks (e.g., eating breakfast; brushing your teeth; walking to the bus stop).

Profile of the SC Graduate Life and Career Characteristics -- Persistence

Academic Language

Vocabulary

- Program
- Algorithm
- Decomposition
- Acute

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- Obtuse
- Right
- Protractor
- Degrees

Objective/Language Function

- Using the appropriate tools, draw and measure a right angle, an obtuse angle, and an acute angle.
- Design a track for an Ozobot using different angle types and incorporate at least 3 different Ozocodes without the Ozobot getting “stuck”.
- Explain verbally how incorporating different types of angles in the design of the track affects the length of time it takes for the robot to complete the track.

Assessment Plan

- Pre-Assessment-
    - Anticipation Guide with questions about self-efficacy and attitudes about programming and/or completing tasks and being persistent.
    - Tableau (angle types: acute, obtuse, right)
- Post-Assessment-
    - Students will input the exact measurement of the angles included in their track on the anticipation guide.
    - Students will decompose the task of creating a track for an Ozobot.
    - Students will return to the anticipation guide to note any changes after the lesson on the “after reading portion”
- Criteria for Mastery:
    - Students should be able to use a protractor to correctly measure an angle.
    - Students should be able to give an example of an algorithm from their daily life and showcase an understanding of decomposition by breaking down the task into smaller steps.

Materials

- Classroom Set of Ozobots with red, green, blue, black thick line markers
  (1 ozobot per group of 2 or 3 students)
- Ledger size white copy paper or white bulletin board paper (large pieces for each group)
- Anchor Chart paper or a white board (to write out tips and tricks)
- Copies of Anticipation Guide
- Protractors
- *Stuck* Read aloud selection
- 2 stopwatches (or a classroom clock with a second hand)

Teacher Preparation

- The day before the lesson, make sure Ozobots are charged.
- Prepare slide show and/or anchor charts with pre assessment questions.
- Procedure for choosing a partner (or assigned partners).

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- Review the Tips/Tricks for working with Ozobots

This lesson introduces the concepts of coding using markers and paper. Students will program the robot to run on a track that includes specific angle types. It will reinforce measurement concepts and measurement of angles by using an authentic task. This lesson would be best after an introduction to angles and several other guided practice opportunities with protractors (specifically measuring obtuse, acute, and right angles). Due to the number of Ozobots in each kit (18), students should work in pairs. Students could design individual tracks and simply share an Ozobot to test their track. Some teachers find it beneficial to allow students 10-15 minutes the day before to go over the mini-lesson for using the Ozobots, having them draw a line and practice drawing one or two codes. This is not necessary, but can be helpful if students have never used Ozobots before.

To keep students on task, it is helpful to stress that during Mobile Maker Kit time, they are the experts and need to help each other if they get "stuck". Remind them to troubleshoot.

The discussion guide is a helpful tool to ensure important concepts are covered. There are suggestions for pre- and post-assessments as a way to measure student learning.

<u>Meat of Lesson</u>

- **Hook**
    1. Have students complete the Pre-Assessment "Before Reading" questions as an entry task.
    2. Tell all students to stand up behind their chair. Do a quick pre assessment/review of angle types. Have students use their bodies to represent the angle types: acute, obtuse, right angle. Chart the terms and the appropriate degrees on an anchor chart for reference during the lesson.
    3. Tell students to use their body to show you an Algorithm without moving. Encourage them to mime any ideas they have. (This will be hard, look around and have any interesting ones share out.)
    4. Have a few students share out if they think they know what an algorithm is.
       Tell students that they will work in a group of 3 or 4 to create a tableau (silent snapshot) of an algorithm from their daily life. Explain that you will be checking understanding by what they create. They should try to incorporate multiple levels (high, medium, and low) but cannot use sounds or props.
       Explain that sometimes tableaus need to be unpacked and explained.
       Give an example using 4 student volunteers:
       (1 student asleep, 1 student getting dressed, 1 student brushing teeth, 1 student eating breakfast)
       Ask students what does the tableau represent?
       Tell them it represents an <u>Algorithm which is a series of steps to perform complex task in this scene the algorithm shows all the steps needed for the program "Getting Ready for School."</u>

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Ask students if they noticed how height was used. (low=student sleeping, medium eating breakfast, high= brushing teeth, getting dressed)
Next, break students into groups and have each group plan to show another example of an algorithm.
Give about 2-3 minutes to plan, and 5 minutes to showcase their tableaus/unpack them.

5. Explain to students that not only do they now know how to create an algorithm, they also just went through the process of decomposition (the breaking down of a complex task into simple tasks). Explain that both of these concepts are very important when programming, which is what they will get to do today. Another very important concept that those in STEM fields have to practice is troubleshooting and finding solutions when they get stuck.

6. Next, Read Aloud: *Stuck*
    a. Read Text.
    b. Discuss book. (see discussion guide)

7. After discussing the book,show students an Ozobot and then display the Ozocodes.
    a. Ask students how they think this Ozobot knows how to move around?
    b. What are the ways that a person can tell the Ozobot what to do? (draw the pattern for a specific movement using the right colors).
    c. Do you think a person could just make a track of nothing but Ozocodes? Why not?
    d. How do you think the Ozobot is able to find the ozocodes?(Sensor)

8. Introduction: In the story, the items in the tree get stuck, but Floyd remains persistent to solve his problem. However, he is so focused on getting the kite unstuck that many other items get stuck. In the end, he finally gets his kite by solving the problem in a unique way, although maybe not the best or the easiest way. However, he didn't give up. We will use all those skills today too as we use measurement tools to practice math and coding skills. **Today, we will use our knowledge about measuring angles in order to design an algorithm for an Ozobot. The Ozobot needs to perform simple tasks using the Ozocodes along the track which will help it reach the finish line.** When you are using an ozocode to tell your Ozobot what to do you are CODING/PROGRAMMING. When you use a series of steps to get the Ozobot to complete a task (i.e.getting a kit unstuck from a tree or finishing the entire track) you've created an ALGORITHM, which is a series of steps to complete a task. There is no wrong way to complete the track on your task card, but there are some things you need to know about the Ozobots in order for them to work for you.
    1) Paper must be flat.
    2) Black track line must be thick and have NO GAPS. Remember it uses a sensor.
    3) Must use the Ozocodes in the right order

- **Brainstorm**
    - Students will need to meet with their partner and get a task card. They will need to read their task card to determine where they want to incorporate all 3 angle types. Remind them that they track should be around 100cm.

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- Students will then need to review the Ozocode handout (having one copy per partnership will be best) to decide which 3 Ozocodes they want to program their Ozobot to do while on the track.

- **Prototype**
  - Students will use their materials to draw a track for their Ozobot and incorporate at least 3 Ozocodes.
  - Students should be encouraged to try out each code as they go to make sure that it works before continuing to draw an entire track. They should also be reminded to test and measure an angle before putting it in their track to make sure their Ozobot won't get stuck. ****This is key, any acute angle below 40 degrees may result in the Ozobot getting stuck****
  - Partner Coding: One students could be the code drawer and the other could be the "driver" and saying the codes/commands aloud to ensure accuracy (for example: The driver would say to the drawer-- "draw 10 inches of black line, 1 cm of red, 1 cm green, 1 cm red, and then make a 90 degree turn to the right."
  - When students have tested and completed their task, they should then measure their course to ensure it is 100cm and has all 3 angle types.
  - If time allows, have students use the stopwatches or the classroom clock to determine how long it takes their Ozobot to complete their course. Encourage students to discuss with their partner design changes they would make if they were going to repeat the task.
- **Share**
  - Have groups take turns walking to see each others Ozobots run the track.
  - Ask students as they are showing off their tracks, what went well? What was challenging?
  - What angles seemed to work best for the Ozobot? Why?

- **Synthesize**
  - Bring students back together for a final discussion. See discussion guide.
  - Reflect on any changes on the anticipation guide "after" section.
  - Complete the exit ticket on the back of the anticipation guide.

Supports for Student Learning
Accommodations

- **ELs**- If students need additional support with the stories, translated copies can be made available. The Ozobot codes are color coded and labeling the code on the final product may be a beneficial task to support learners. Due to the visual and hands on nature of this lesson, there is little written work, but students could be given pictures or word choices for the pre/post assessment blanks.
- **Grade Level adaptations**- Depending on grade level, read aloud may need to be adapted (For example: K read:*How Big Is a Foot? Or Measuring Penny!*, for conversion

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4th grade read:*How Tall? How Short?How Far Away? Other Ozobot Maker Lessons are available on the website www.mobilemakerkits.com*)

- **Advanced students**- Have students measure their track with 2 other units of measurement and label each one on the track. Compare results with another group. IF students are advanced in programming they may want to explore using iPads and coding with Blockly for the Ozobots.
- **Additional supports** -- If your students have never used the Ozobots before it may be helpful to take about 10-15 minutes a day or two before to model creating lines and Ozocodes. This could be done watching a quick video or if time allowed and the kit was available to let them draw a line with one code to have the experience before the lesson. Students with difficulty using fine motor skills could also use printed stickers of the codes to create their track, but those would need to be prepared in advance.

Discussion Guides

- Read Aloud-
    - What is the original problem of the story?
    - Floyd wanted to do something, but encountered a problem. How did he go about trying to solve the problem?
    - What characteristics or habits of mind does the character portray in his approach to the problem?
    - Did Floyd solve his problem of being “stuck” the way you thought he would?
    - How might this problem and or the character traits of Floyd relate to designing something new, measuring angles, or trying to learn more about coding?

- Synthesis-
    - Which angle was the easiest to draw? Why?
    - Which angle was the easiest to measure? Why?
    - Were some angles easier for the Ozobot to read and travel by? Which ones?
    - Why might some bots take longer than others to complete the tracks even if the measurements of the tracks and angle types were the same?
    - Were there any Ozocodes that were difficult to incorporate into your track? Why do you think that was?
    - What was challenging about this lesson? What was fun?

More to Explore (Resources)

- Introduction to coding not using the markers see (Blocky)
- Education: Ozobots https://portal.ozobot.com/lessons/detail/ozo-dash-100
- Similar Read Alouds: http://www.chrisvandusen.com/
- Code.org Elementary: https://code.org/educate/curriculum/elementary-school
- SC Computer Science Standards: https://ed.sc.gov/instruction/standards-learning/computer-science/standards/

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