Angles in Polygons

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Task Overview

Task Description

Students will use prior learning of interior and exterior angles in polygons from Grade 8 to introduce/reinforce coding using Scratch by drawing different polygons. Students will then introduce a variable in order to accept user input to create a polygon with any number of sides. As an extension, students can challenge themselves by creating a 2D shape or pattern.

Adapted from: Angles in Polygons with Scratch by Patricia Clark, Dubravka Lisak, Dianne Dreef

Big Idea

Mathematical concepts and relationships can be modeled and problems can be solved through coding.

Duration

Approximately 2-3 periods

Recommended Materials

- Scratch and a device (chromebook) to access

Learning Goal(s)

- To become familiar with how to use the Scratch Programming Language
- To write and execute efficient code that draws polygons, using knowledge of interior and exterior angles.
- To use variables in coding in an iterative process

Sample Success Criteria

- I can write and execute code in Scratch
- I can code a sprite in Scratch to draw a square
- I can code a sprite in Scratch to draw at least 4 different polygons
- I can explain what angle measurement I need to use to draw each polygon
- I can explain the difference between an interior and exterior angles
- I can explain the relationship between interior and exterior angle
- I can explain why my code is efficient
- I can use variables in coding in order to accept user input
- I can explain how a sub-program works when coding

Overall Expectations

AA1. Social-Emotional Learning Skills

develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands

A1. Mathematical Processes

apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

C2. Coding

apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands

E1. Geometric and Measurement Relationships

demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations

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Social-Emotional Learning (SEL) Skills

- Recognizing and Identifying Emotions That Support Mathematical Learning
- Recognizing Sources of Stress That Present Challenges to Mathematical Learning
- Identifying Resources and Supports That Aid Perseverance in Mathematical Learning
- Building Healthy Relationships and Communicating Effectively in Mathematics
- Developing a Healthy Mathematical Identity Through Building Self-Awareness
- Developing Critical and Creative Mathematical Thinking

** This overall expectation is to be included in classroom instruction, but not in assessment, evaluation, or reporting. See **further information** about approaches to instruction that support all students as they work to apply mathematical thinking, make connections, and develop a healthy identity as mathematics learners to foster well-being and the ability to learn mathematics.*

Mathematical Processes

There are opportunities for students to engage in the **mathematical processes** throughout this task. For example:

Problem Solving: critical thinking, math identity, knowledge, collaboration, lived reality, creative thinking, confidence

Reasoning and Proving: justification, proportional reasoning, algebraic reasoning, spatial reasoning, numbers, operations, geometric properties, measurement

Reflecting: identify what is working, what isn't working, appropriate strategy, reasonableness of their answer

Connecting: connect different mathematical concepts

Communicating: share ideas, understandings and solutions, provide feedback, pose questions

Representing: represent math relationships using pictures, diagrams, numbers and symbols

Selecting Tools and Strategies: test, revise, confirm reasoning, remembering how they solved a problem

Prior Learning and Placement of Task during Semester

Prior learning for coding will be different for all students. This slide deck can be used as a coding diagnostic tool and/or a form of reviewing elementary coding material and vocabulary. Each expectation and grade is specified within the speaker notes and is directly related to this grade 9 task.

Elementary Coding Connections

Interior and exterior angles of polygons is a concept that was formerly in the grade 9 curriculum. Students are now introduced to the angle relationships in grade 6. They then use them as they describe and represent geometric shapes in grade 8.

This task is well suited as an introduction to coding and as such would be best placed before doing any other coding, perhaps toward the beginning of the course.

The various parts of this task could be done immediately one after the other or each one could be done, in order, at different times during the course.

Vocabulary

- Naming conventions for Polygons & Regular Polygons
- Interior and Exterior Angles
- Angle Measures
- Sprite
- Variable

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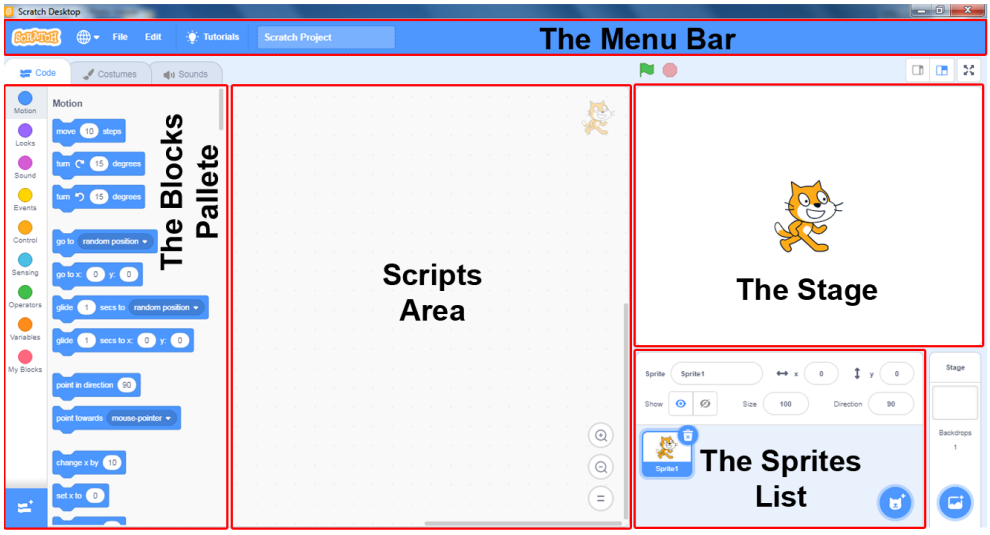
Diagnostic Task & Look fors

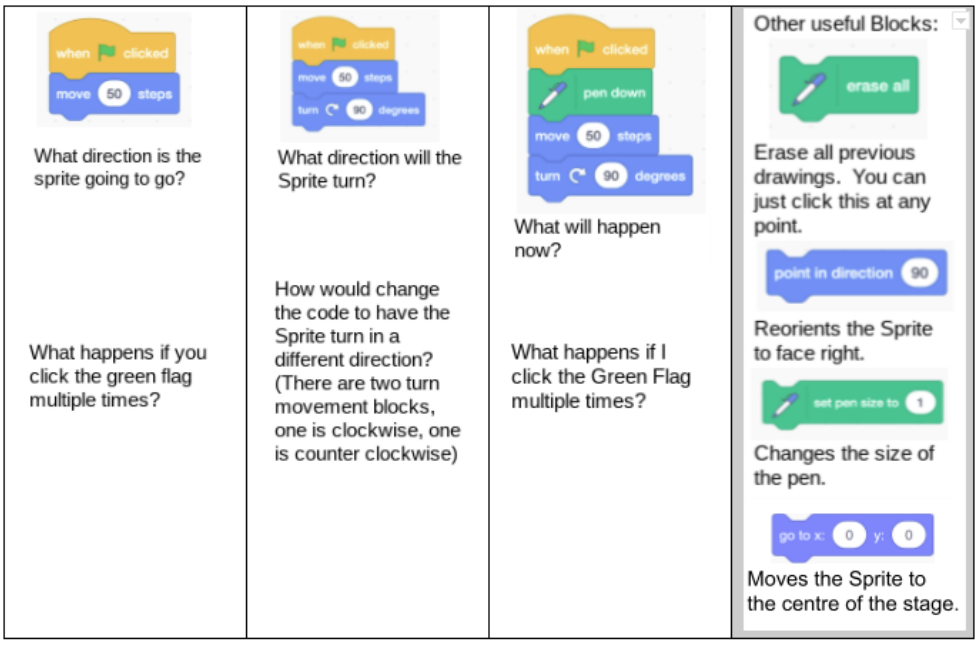
The following is available as a student handout.
An alternate unplugged version is also available.

Diagnostic Task (optional - for students who may not have used Scratch):
If students are new to Scratch, you may want to start with an introduction: Tour of the Scratch interface (see below) - Sprite, Stage, Block Area, and Scripting Area



You may also have to demo how to **Add the pen extension by clicking:**  **(extensions found at the bottom left corner in Scratch)**

Do some coding example walkthroughs with the students to see if they could predict what happened such as:



Teacher Notes

Although most students have seen Scratch in previous grades, those who have not can easily pick it up by completing this activity. This is also a good entry point for teachers who have not coded or used Scratch before. An example code is provided which can be duplicated and then run to help with the thinking required to understand the code.

We recommend teachers ask for an educator account at least 24 hours before using it with your class. It will allow you to have students join a class that you create, saves their work, and easily see and share their coding projects. The link to register for an eductor account is here: https://scratch.mit.edu/educators#teacher-accounts

The diagnostic can be done orally or provide the student copy.

If there are a number of students trying to connect to the Scratch interface at once, it can take a couple of minutes to load.

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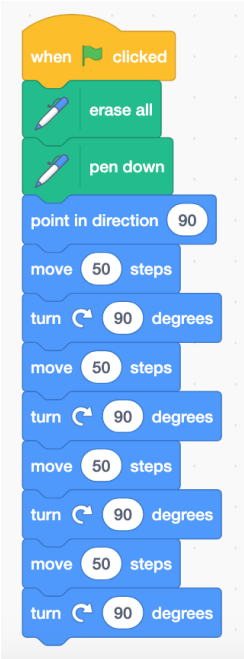
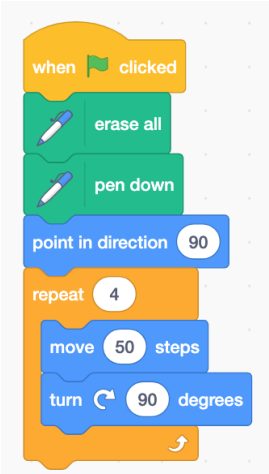
Students then try themselves.

Prompt: Create a square using Scratch.

The code can be either one of the following, the second one is using a loop as the same code is being repeated 4 times:





Look Fors

- How familiar are students with Scratch Programming Language?
- Do students make any connections to interior and exterior angles?

It's important to identify the differences between these two ways of coding a sprite to draw a square. The one on the right is more efficient with the repeat loop.

The interior and exterior angles in a square are the same, so students might not see that the code rotates with the exterior angle yet.

This Geogebra link could be used to reinforce the relationship between exterior and interior angles if it comes up in the diagnostic.

Task

The following is available as a student handout.
An alternate unplugged version is also available.

Students will work on Scratch by drawing polygons.
Part 1: Create four different polygons using Scratch.

Sample code is provided below.

Teacher Notes

Students might create regular and/or irregular polygons.

Students may need to play around with how many degrees to turn, and that the turn represents the exterior angle, not the interior angle (this Geogebra link can help). This may not be obvious after drawing the square in the diagnostic task as the exterior and interior angle are the same. However, this may lead to bringing out the relationship that the interior and exterior angle are supplementary.
The sample code provided are

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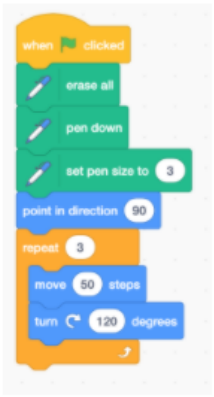
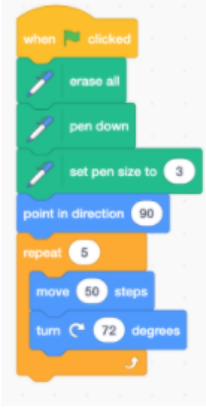
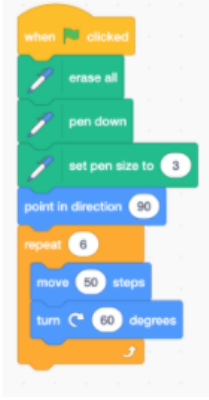
Triangle:	Trapezoid:	Pentagon:	Hexagon:
			

Reflect & Consider:

- What did you learn and how does it connect to your prior math?
- What other connections do you see ?

ways one could code the drawing of a regular triangle, pentagon, hexagon and a trapezoid.

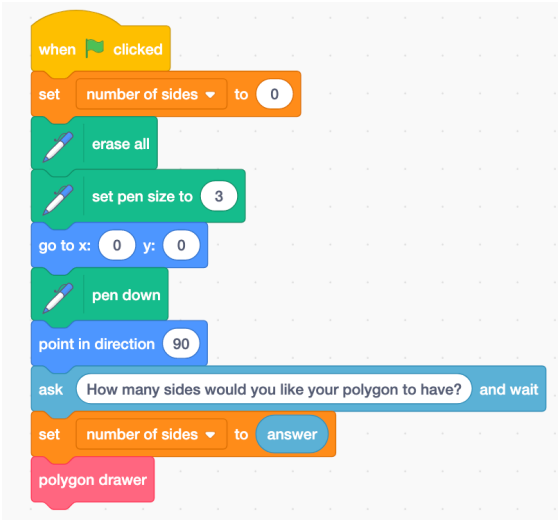
Part 2 - Introducing the Variable

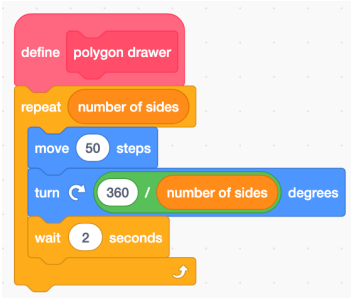
Prompt: How could you alter your code so a user could input a number and the sprite draws a regular polygon with that number of sides?

Allow students to choose from the options below based on their own readiness.

- Option 1: Start from scratch
- Option 2: "Skeleton" code with missing information to fill in
- Option 3: Suggestions for code to investigate - input, creating a variable, repeat
- Option 4: All coding blocks are in the scripts area and need to be placed together - Polygon deconstructed

Possible solution





In coding, a variable is a temporary storage location for data such as a numerical value or a series of characters, and the values stored in that location vary depending on the commands given by the program.

Additional extensions:

- Error check user input for number of sides that are not possible
- Have the program output the interior angle, exterior angle and/or number of sides of the polygon
- Have the program output the name of the polygon based on the number of sides

In coding, words are often used instead of a letter, such as FirstNumber + SecondNumber = 3

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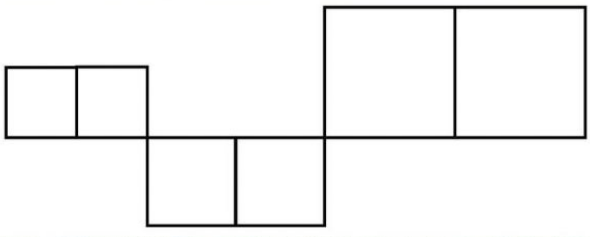
Part 3 (extension possibly) - create your own art, 2D composite shape, repeating pattern or similar shapes. Example:  Sample code for Example diagram.	Encourage students to play by adding sound and colour. Providing samples here could be useful, but students are encouraged to design their own. Students may have to change the location of their Sprite in order to create their design. The “go to x: __ y:__”, “go to _____” and the “change” or “set” x and y code blocks would be useful..

Assessment

One-Point Rubric - modify the rubric based on how far students get working on this task

Articles: Single Point Rubric
6 Reasons to Try a Single-Point Rubric

Self-Assessment: Scale (Print Version)
Self-Assessment: Scale (Virtual Version)

This task can be included in the **Student Portfolio of Process Expectations** (Google Slides)

Teacher Reflections

We were so impressed by how engaged all of the students were. Everyone was able to draw at least 3 shapes and students who had never coded before were coding. We honestly had students cheering that they were able to code different shapes. I think it really helped students solidify their understanding about the difference between interior and exterior angles and how to determine the measures of these angles.

Some students created one long program to draw all shapes and use the “pen up”, “go to x:___ y:___” and “point in direction 90” control blocks. I had a student who was able to code an application that asked for the number of sides, then drew the polygon with that number of sides. The student even put in error checking to make sure it didn’t go over a certain size because it wouldn’t fit on the screen.

Additional Resources

Coding with Scratch 3.0 Workshop for Staff @ OCDSB
Scratch Tutorials
Scratch Wiki - good for answering your Scratch questions
Computer Science in Algebra courses by Code.org
TVO - Intermediate Coding and Mathematics