Drexel-SDP GK-12 ACTIVITY

Tesselations With Scratch

Subject Area(s)   Science & Technology, Geometry

Associated Unit   Scratch Computer Programming

Associated Lesson

Activity Title   Tessellations with Scratch

Grade Level 5 (4-8)

Time Required   30 minutes

Group Size 1

Summary

This activity is designed as a follow up activity to the Introduction to Scratch lesson. Students will build upon their existing programming skills to explore tessellations. They will create a short program that draws a tessellation. The students can then modify the program and discover the relationship between the angles and the tessellation.

Engineering Connection

The use of models and simulations is visible in the engineering and science disciplines. Models enable engineers to view items such as, the solar system (Astronomy), car engine (Mechanical Engineer), housing community (Civil Engineer), or cells (Biochemical Engineer) that are either too large, small, expensive, or impractical to view otherwise. Engineers use simulations to test theories or scenarios before or while they are constructing the actual objects. Simulations are also valuable when the real scenario, such as an evacuation of a city, is impossible to create.

Keywords

Computer Science, Software, Programming, Technology, Scratch

Educational Standards

- Math: 2.4.5 Mathematical Reasoning and Connections

- Math: 2.9.5 Geometry

Pre-Requisite Knowledge

Students should have familiarity with the Scratch programming environment. Students should be familiar with the properties such as the degree and number of angles and relationship of angles and sides, of geometric shapes such as rectangle, octagon, and triangle.

Learning Objectives

After this lesson, students should be able to:
- Understand the relationship between the angles of a polygon and the polygon's ability to tessellate.

- Be more familiar with Scratch.

Materials List

Each student needs:
- A computer with the Scratch environment installed.

To share with the entire class:
- A projector that can display images to a screen.

Introduction / Motivation

Imagine putting a puzzle together and think about how often you rotate and turn the pieces to see if they'll fit where you want them to go. In doing this you've noticed that certain shapes can fit next to each other when rotated and that others don't follow this pattern. When geometrical shapes are moved around in this manner they are said to be transformed. One specific arrangement shapes is called tessellations. Shapes are tessellated when they fit together to fill a plane surface without any gaps in the tiling.

In this lab you will use Scratch to examine polygons and identify the properties of geometric shapes that enable them tessellate.

Vocabulary / Definitions

Word	Definition
Scratch	Programming environment developed at MIT for children's programming, www.scratch.mit.edu
Polygon	A plane figure with at least three sides
Tessellate	Repeated use of a single shape without gaps or overlapping

Procedure

Background

Students require previous experience with the Scratch environment. It is assumed they are familiar with the concept of tessellations.

Before the Activity

- Discuss the properties of polygons and tessellations with students.

With the Students
1. To begin the exercise with a new Scratch file select "New" on the main Scratch menu.
2. Ask students for ideas on creating a script that will draw a polygon on the stage. For example:
   a. Select a pen color
   b. Select pen down
   c. Move forward 60 (or a similar value) steps
   d. Turn 90 (or another value) degrees
   e. Repeat 3 more times (this will vary depending upon the angle chosen above ex. Repeat 3x with 120 degrees or 6x with 60 degrees). This can also be executed in a "Repeat #" control block.

   The important point is to have students create a polygon and understand the relationship between the number of sides and the measure of the angles. The sum of the interior angles should equal 360 degrees.
3. Ask students how they can create a tessellation (see Figure 2). To the script add:
   a. Nested repeat loops
   b. An additional turn 90 degrees (or the appropriate angle based upon the original selected angle).
   c. If desired change the pen color to highlight the different polygons drawn.

   The important point is to have students realize that the sum of the angles where the polygons meet is equal to 360 degrees. Not all shapes tessellate so the interior angle of the selected shape has to be a divisor of 360 degrees.
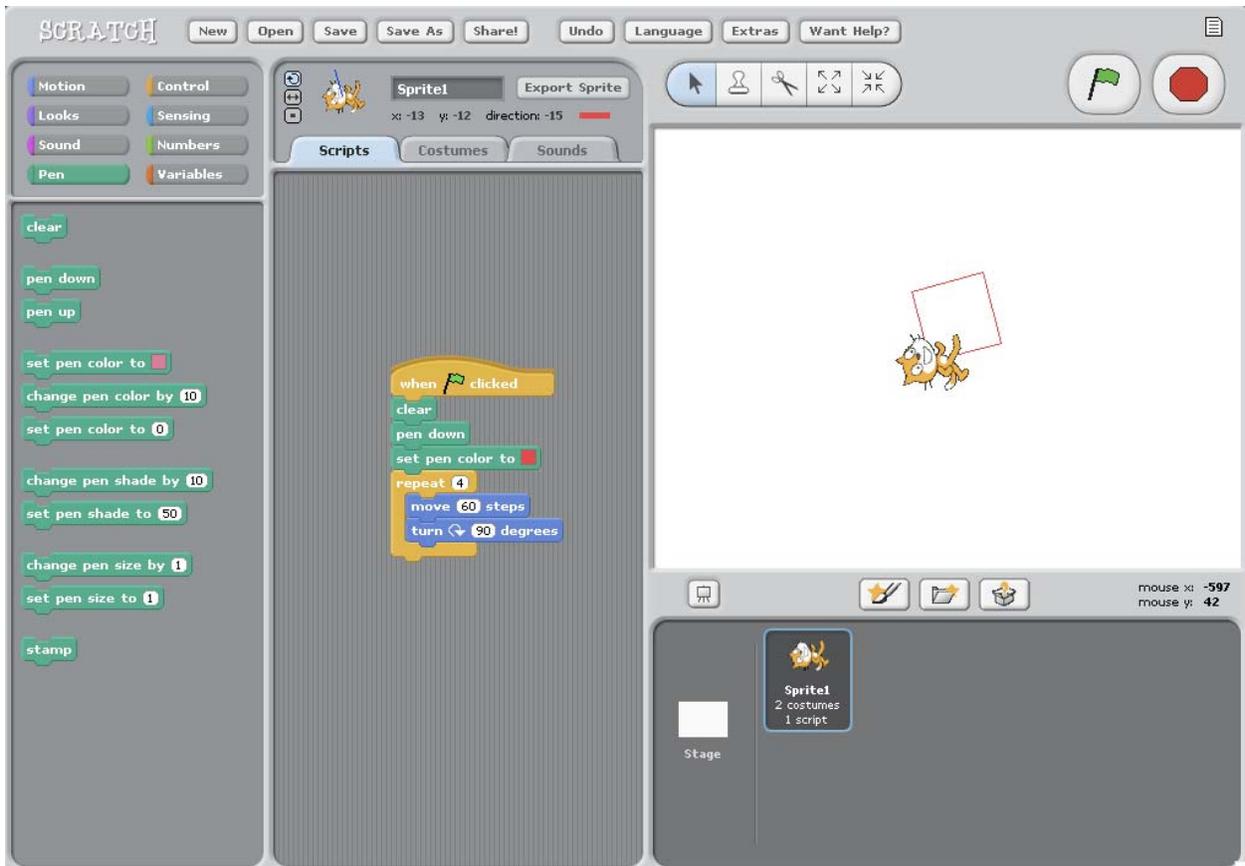
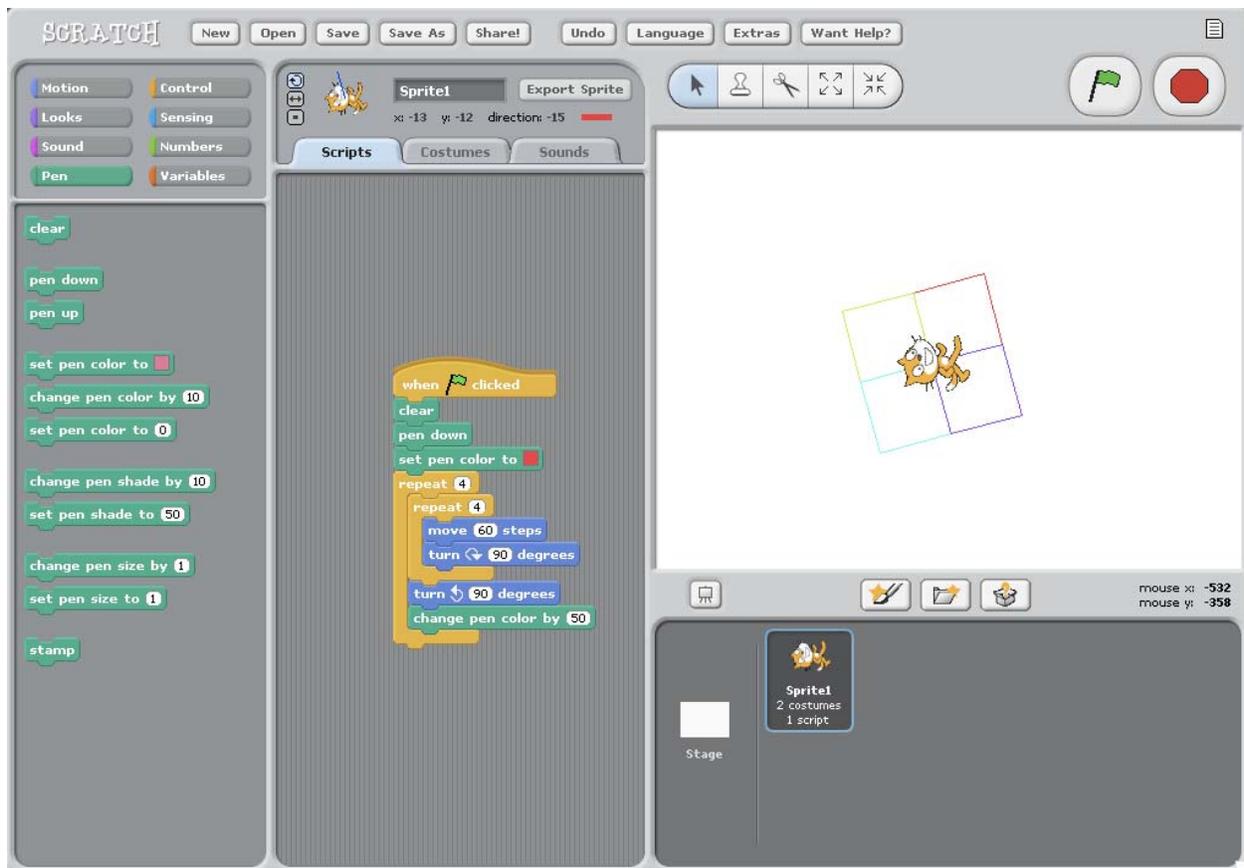**Image**

Figure 1 Single Polygon

Figure 2 Tessellation Program

Troubleshooting Tips

If the scripts do not produce either tessellations or polygons verify the sum of the angles of the polygon is 360 degrees and the sum of angles around a vertex is also 360 degrees.

Changing pen colors during each step enables students to see what their scripts are doing.

Assessment

Pre-Activity Assessment

Talk to students about the properties of polygons. Discuss the relationship between number of sides and the degree of the interior angles. Discuss the similar and dissimilar properties of polygons.

Activity Embedded Assessment

- Ensure that students are able to draw a single polygon on the stage. This entails knowledge of Scratch and polygons. You can visually check whether or not the student has written a program that draws a polygon. Another method of verification is to multiply the selected angle by the number of sides. This should total 360 degrees.
- Ensure that students are able to write a program that draws a tessellation. This entails knowledge of Scratch, polygons, and polygon properties that enable tessellation. You can visually check whether or not the student has written a program that draws a tessellation. Another method of verification is to sum the angles around the point of tessellation to it is 360 degrees. Additionally, all of the shapes must be the same.

Post-Activity Assessment
  Ask students how changing the interior angles affects the number of sides required to make create a polygon. Correct answers will include any in which the sum of the interior angles is 360 degrees. Changing the interior angle will create a polygon if the new angle is a divisor of 360. The number of sides is equal to the number of times 360 can be divided by the new angle.
  Ask students how many shapes would be needed to tessellate around a vertex given one interior angle. The number of shapes is the same as the number of interior angles. The polygons cannot overlap or have gaps in the tiling.

References
Scratch – www.scratch.mit.edu

Owner
Drexel University GK-12 Program

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