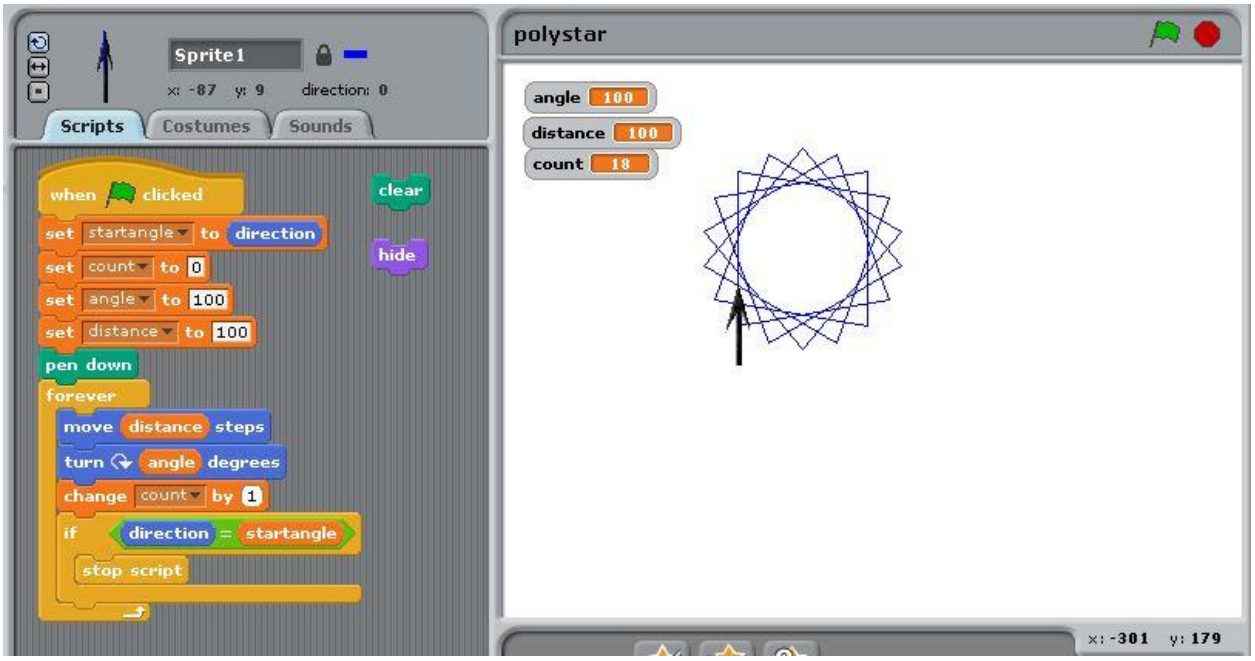
Mathematical Experiments with Polystar
By Dan Lynn Watt

In this activity we will explore the behavior of a script, *Polystar*, to create geometric designs using two variables, *distance* and *angle*.

To use *Polystar*, set values for the *angle* variable and the *distance* variable by entering numbers in the script window and clicking the flag.



The stage window at the right in the figure above shows what happens for an *angle* of 100 and a *distance* of 100.

How do you think the shape might change if you increase or decrease the value of the *distance* variable by 10?

How do you think the shape might change if you increase or decrease the *angle* variable by 10?

Working with *Polystar* is about creating interesting designs and paying attention to the variables that are used to create them. Think of yourself as a scientist, investigating the behavior of a strange machine. Or as an artist, investigating the potential of a creative medium. Or as a mathematician investigating the relationship between geometric and numerical patterns.

Your task is to learn as much as you can about the behavior of the script: to understand the behavior of *Polystar* so well that you can predict exactly what the result will be for any value of *angle* and *distance* variables. You will need to describe the mechanical behavior of the script—what it makes the sprite do when *Polystar* runs – and the mathematical rules linking *Polystar's* variables to the resulting designs.

It's good to work in groups of 2 or 3 people at a computer. Then collaborate with other groups to combine and compare results. Make sure that each group includes a scribe or recorder.

RECORD YOUR RESULTS AND YOUR CONJECTURES ON THE POLYSTAR EXPERIMENT RECORD SHEETS (PAGES 6 and 7 OF THIS DOCUMENT).

The next few pages give some specific questions and challenges that you can use if you wish to help you get started.

Here are some starting points for *Polystar* explorations:

1. Try *Polystar* with a variety of *angle* and *distance* variables. Keep records of the results. What type of designs does it make? Do any of the designs have names that you know? Can you invent names for unfamiliar designs?

2. What does the *angle* variable control? What does the distance variable control? Make a conjectures about this. Then invent some experiments to test your conjectures.

3. Expand the kinds of values you use for the variables. large numbers, small numbers, negative numbers, fractions, and decimals. Make predictions about what will happen.

WARNING:

SOME VALUES OF THE VARIABLES WILL CAUSE THE SPRITE TO HIT THE EDGE OF THE SCREEN. WHEN THIS HAPPENS, JUST CLEAR THE SCREEN, MOVE THE SPRITEB TO A GOOD STARTING PLACE AND START AGAIN.

4. Try some of the visual challenges on the following pages.

5. As you work, write down any questions you have about *Polystar* or conjectures that you make. Devise experiments to try to answer the questions or test the conjectures.

6. As you work, record your data on the *Polystar* experiment record sheets.

Conclusions: Can you predict the type of shape and the number of points if you know the values of the *angle* and *distance* variables.

VISUAL CHALLENGES

1. Find the angle and distance variables to make each shape

A. angle ___
distance ___

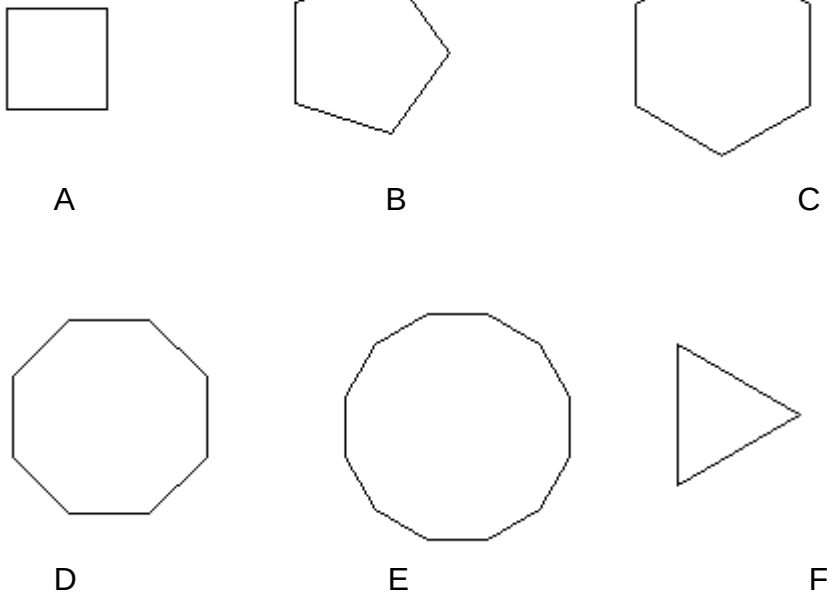
B. angle ____
distance ____

C. angle ____
distance ____

D. angle ___
distance ___

E. angle ____
distance ____

F. angle ____
distance ____



2. Find the variables needed to make each shape. Hint: the angle value is between 90 and 180

G. angle
distance

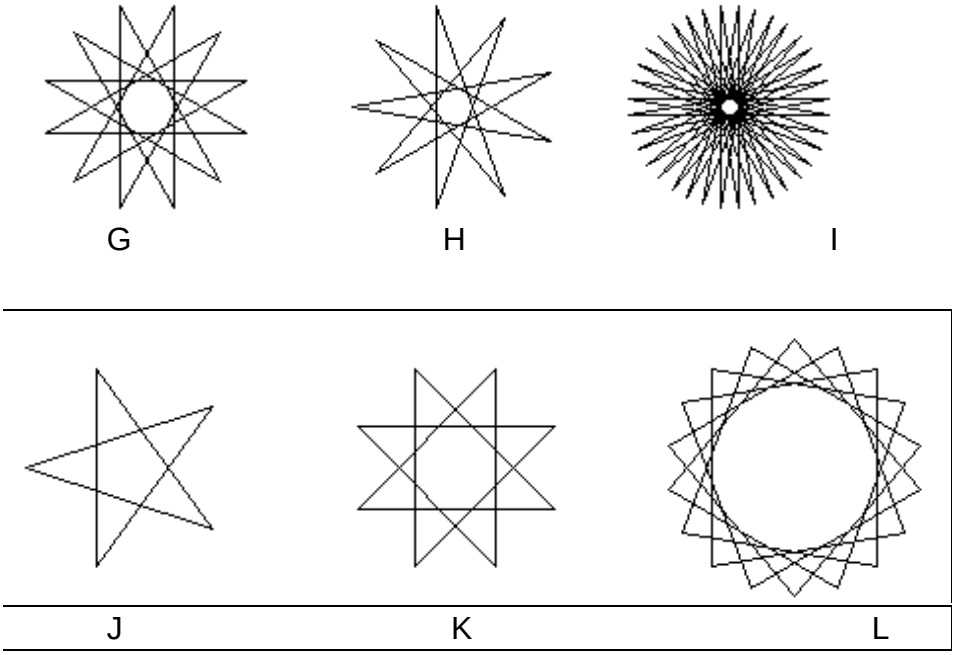
H. angle ____
distance ____

I. angle ____
distance ____

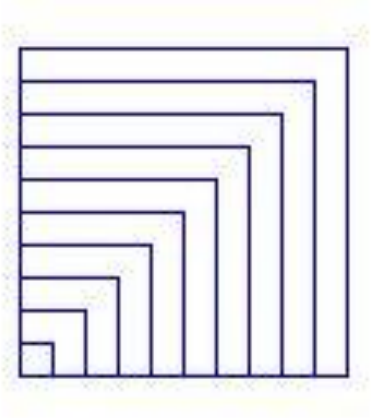
J. angle _____
distance ____

K. angle ____
distance ____

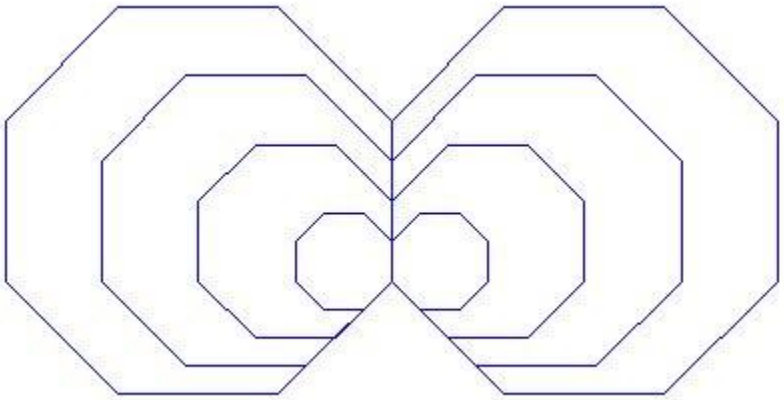
L. angle ____
distance ____



3. Find the variables needed to make this pattern of *Polystar* shapes.



4. Find the inputs needed to make this pattern of *Polystar* shapes.



5. Make your own designs. Be sure to record the values of the *angle* and *distance* variables you use.

Polystar Experiment Record Sheet

The headings below are for you to use to record your thinking during this investigation. They are in no particular order, and additional pages are available if you want to use them.

You can record your data on the next page. Make as many copies as you need.

Questions:

Conjectures:

Descriptions of Experiments:

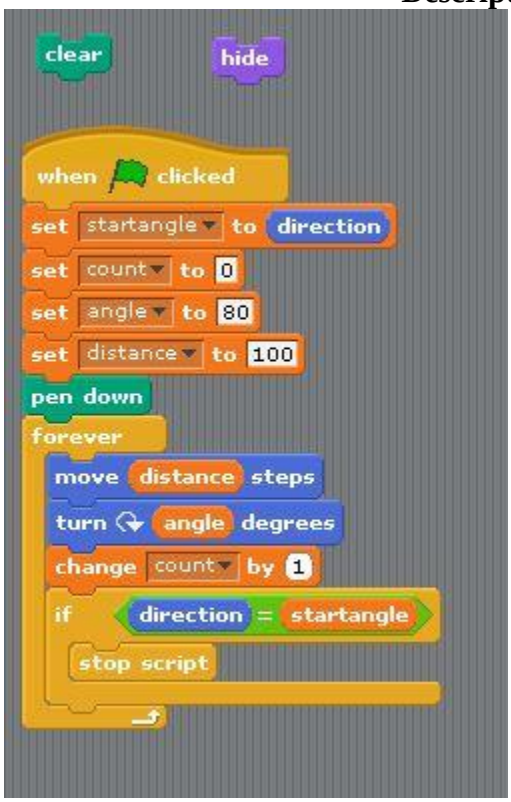
Observations and Findings:

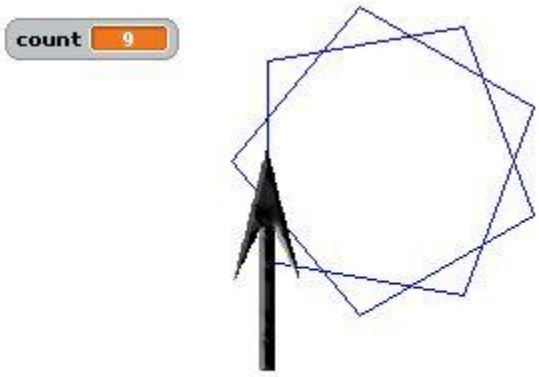
Which of the variables, the *angle* or the *distance* determines the number of points in a *Polystar* design? Make a chart like the following to collect your results.

Get as much data as you can for this chart. Collaborate and share data with other groups.

Angle variable	Distance variable	Number of points	Polygon or Star?

Description of Polystar Program





Polystar Design with *angle* 80, *distance* 100

Note: Sprite costume is chosen to show its direction of motion.

PROGRAM EXPLANATION

VARIABLES:

Startangle – this value is used to stop the program when the sprite returns to initial direction.

Count – this keeps track of the number of sides or vertices in the design

Angle – the turn variable

Distance – the move variable

STARTING BLOCK:

Sets *startangle* to the sprite's current direction (this allows for designs in different orientations;

Sets *count* to 0.

User enters values for *angle* and *distance*.

MAIN BLOCK
Moves and turns the sprite over and over;

Increments count by one.

If *direction* = *startangle*, all scripts stop.

SUGGESTION: Add a *wait* block to the main block to slow down the action so you can see what is happening. Set the *wait* value to 0 to make the action fast again.