

# Level Three: Recursion



## Discovering Computer Science & Programming through Scratch

# Student Notebook

Updated for Scratch 3.0



# Discovering Computer Science: Recursion (Level Three)

## Student Notebook

This notebook provides a place to record and share your thinking and problem-solving as you explore, test, and evaluate computer programming with Scratch.

Use this notebook with the 4-H curriculum manual, ***Discovering Computer Science & Programming through Scratch Level Three: Recursion***. Make it a reference for yourself and use it to show others what you have learned!

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Scratch is a project of the Lifelong Kindergarten Group at the MIT Media Lab ([scratch.mit.edu](https://scratch.mit.edu)). Images of the Scratch cat are used with permission. All other screenshots and images used in this guide are licensed under the Creative Commons Attribution-ShareAlike License.

# Your Scratch Scrapbook

As you complete Scratch activities, document each in your Scratch Scrapbook.

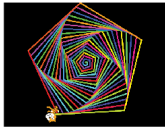
The Scrapbook begins on **page 19** of this book. Directions for completing the Scrapbook are also on **page 19**.

## My Scratch Scrapbook

On these pages create a Scrapbook documenting your Scratch activities.

- For each activity included in your Scratch Scrapbook be sure to:
  1. Take a **screenshot** or create a **drawing** showing the activity.
  2. Give the **title** you gave the activity.
  3. Share your activity and **give the link** to your Scratch activity.
  4. Give a **summary** telling how to start the activity and what the activity does.
  5. Tell about something you **learned** from this activity.

**Sample Entry**



**Title:** Spinning Spiral Polygons Recursion  
**Link:** <https://scratch.mit.edu/projects/308818797>  
**Summary:** Set the variable for the #ofSides. Click the green flag. The cat will draw any spinning, spiral polygon.  
**Something I learned:** I remixed a project and experimented with the angle measure of the turn. I found that when you increase the turn by 1 degree and decrease the number of steps by 4, the script creates fun, spinning-spiral shapes.

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# Using this Notebook

## How to Follow Along

Page numbers throughout this book, shown like the example to the right, refer to the page numbers in the *Discovering Computer Science & Programming through Scratch Level Three: Recursion* book.



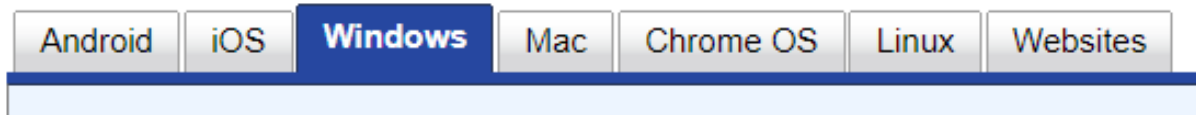
▶ page #

## How to Take a Screenshot

Throughout this notebook, you are asked to take a screenshot of a script or activity you create to print and attach for others to see. If you are unsure how to take a screenshot on your computer, follow the directions at:

[www.take-a-screenshot.org/windows.html](http://www.take-a-screenshot.org/windows.html)

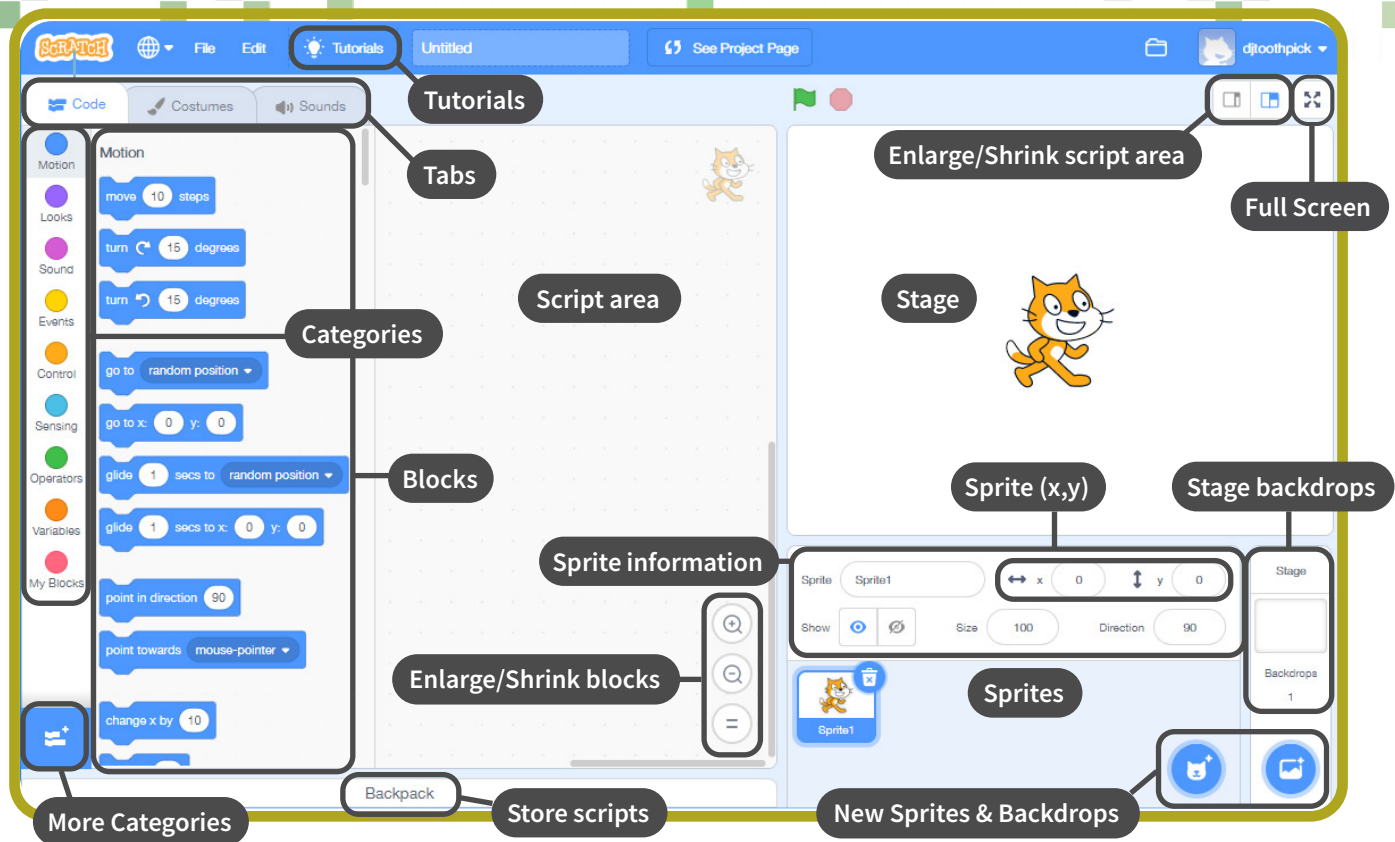
At this address you can click on directions for all of these operating systems:



- **Windows:** Use a built-in screenshot tool called **Snipping Tool**. Watch this YouTube video called, “How to Use Snipping Tool Beginners Guide” for instructions. [www.youtube.com/watch?v=2O932t8-k2A](http://www.youtube.com/watch?v=2O932t8-k2A)
- **Mac:** Follow these instructions found at this address from Apple support: [support.apple.com/en-us/HT201361](http://support.apple.com/en-us/HT201361)

Or watch this YouTube video called, “How to take a screenshot on your Mac — Apple Support” for instructions.

[www.youtube.com/watch?v=pHDDfng5yC8](http://www.youtube.com/watch?v=pHDDfng5yC8)



## Scratch Environment

**Stage:** The area where the Sprites appear

**Sprites:** Objects that move about the stage

**Sprite information:** Shows sprite's name, location, visibility, size and directions it is pointing

**Sprite (x,y):** Shows the (x,y) coordinates of the selected Sprite on the stage

**New Sprites & Backdrops:** Used to add or create new sprites and backdrops

**Blocks:** Items or tiles used to command your Sprite to perform an action

**Enlarge/Shrink blocks:** Enlarge (+) or shrink (-) size of blocks to make them fit easier in Script area

**Script area:** Area to place blocks or scripts—Right click the background of the Script Area to Undo, Redo, Clean up Blocks, Add Comment, Delete

**Tabs:** Switch between Scripts, Costumes, and Sound

**Categories:** Click each to show blocks in that category—Blocks are color coded in each category

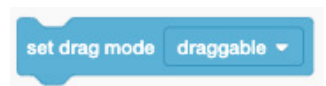
**More Categories:** Click to show categories that are not listed until you add them to the category list

**Stage backdrops:** Used to change the background of the stage

**Tutorials:** Shows helpful tips, frequently asked questions, and activity suggestions

**Backpack:** Store a script or Sprite here so it can be used in other Scratch projects

**Full-Screen:** Show only the stage area on the screen—To drag a Sprite around the stage in full-screen, use this block from the **SENSING** category

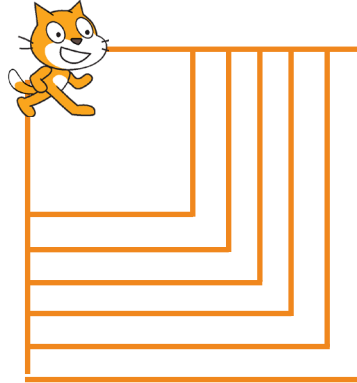


# Parameters

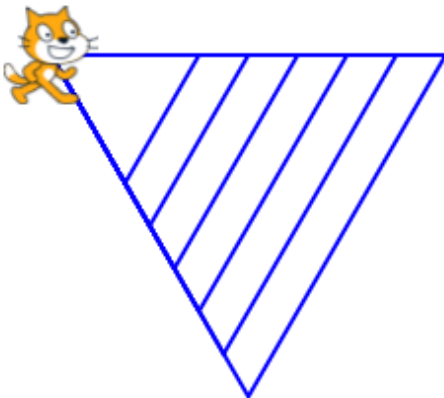
▶ page 6

## Creating Blocks that Accept Input

- Create a script that uses a **square** block with a parameter for **sideLength** to draw squares of several sizes like the squares to the right.
- Take a screenshot of the script and attach it next to the squares.



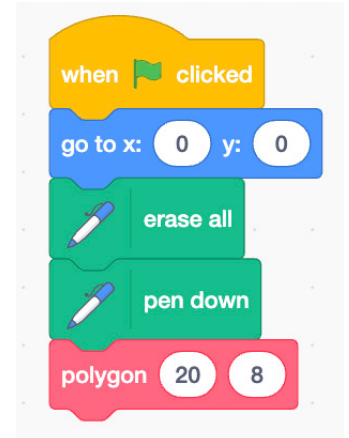
- Create a script that uses a **triangle** block with a parameter for the **sideLength** to draw triangles of several sizes like the triangles below.
- Take a screenshot of the script and attach it here.



**Include this activity in your Scratch Scrapbook!**

## Generalize Further

- Look at the script to the right. Predict what shape is created when the green flag is clicked. Sketch your prediction here.



- Look at the script to the right. Predict what shape is created when the green flag is clicked. Sketch your prediction here.



- What happens when the input numbers are reversed in the **polygon** block? Why?

- Change your code to create a multiple-polygon picture like those shown in the **Challenge** on **page 10**.
- Take a screenshot of the picture, print it, and attach it here.

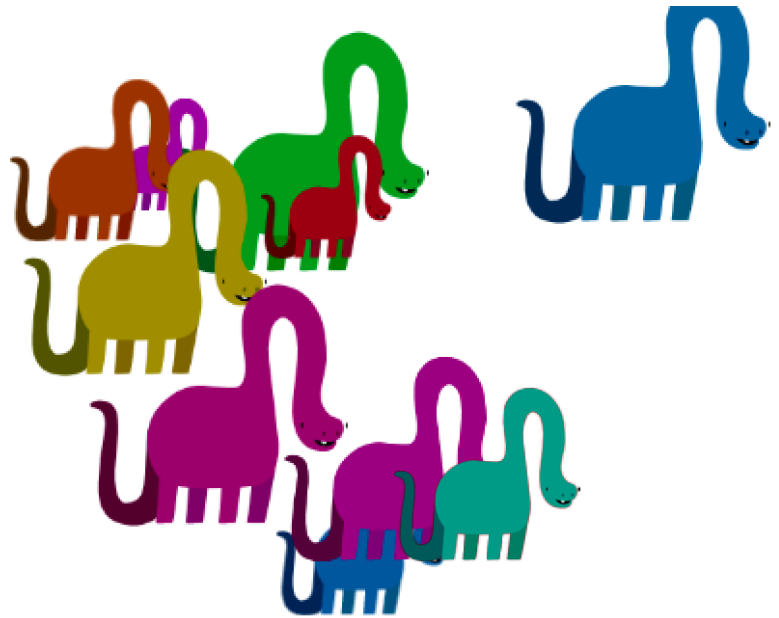
**Include this activity in your Scratch Scrapbook!**

## ▶ page 11 Dinosaurs

Create your own colorful picture like the dinosaurs shown to the right.

Use only one sprite and a customized block in the script. That block should have parameters for size, color, and x and y locations.

The script should include **wait, forever**, and **repeat** blocks so that after drawing 10 random copies of your sprite, the script pauses for a bit, erases all the random copies, and draws 10 new random copies. This should continue forever.



- Take a screenshot of your picture, print it and attach it here.

**Include this activity in your Scratch Scrapbook!**



# Recursion

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## The Handshake Problem with Iteration

- Complete this table.

# of People in the Room	# of Handshakes
1	
2	
3	
4	
5	
..	
100	

```
when clicked
  set #ofHandshakes to 0
  set #ofPeople to 0
  repeat 10
    set #ofPeople to #ofPeople + 1
    set #ofHandshakes to #ofHandshakes + #ofPeople - 1
  say #ofHandshakes for 2 seconds
```

- What does the cat say and do when the script to the left is run?

```
when clicked
  set #ofHandshakes to 0
  set #ofPeople to 0
  repeat 10
    set #ofPeople to #ofPeople + 1
    set #ofHandshakes to #ofHandshakes + #ofPeople - 1
  say #ofHandshakes for 2 seconds
```

- What does the cat say and do when this script to the left is run? How is this script different from the one above?

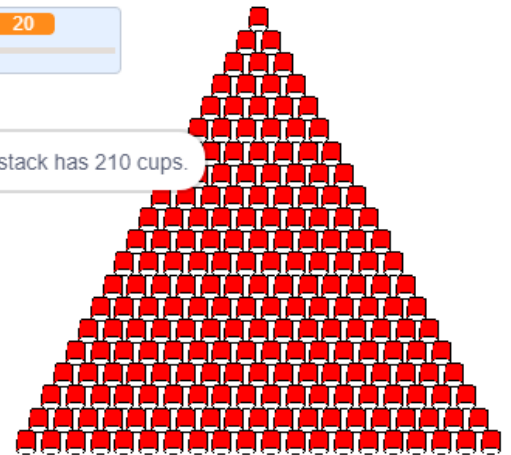
To see a demonstration of the Handshake Problem, go to: [scratch.mit.edu/projects/154903794](https://scratch.mit.edu/projects/154903794)



Take a screenshot of the script you create for the **define find#ofCups (#ofLayers)** block. Print it and attach it here.



This stack has 210 cups.



If your recursive script is correct, it tells you that for 20 layers of cups, you need to use 210 cups. Is your script correct?

- How many cups are there in 30 layers?
- How many cups are there in 40 layers?





- How did you find the **base case** in the **Handshake** problem?
- How did you find the **base case** in the **Stacking Red Cups** problem?
- How did you find the **recursive rule** in the **Handshake** problem?
- How did you find the **recursive rule** in the **Stacking Red Cups** problem?

**Include this activity in your Scratch Scrapbook!**



# Square Spiral

- Complete this table.

Square Spiral	Picture	Length of Longest Segment
With 1 segment		Purple segment is 2 steps
With 2 segments		Red segment is 4 steps
With 3 segments		Green segment is 6 steps
With 4 segments		Blue segment is 8 steps
With 5 segments		
With 6 segments		

- How long is the 10th segment? How do you know?

