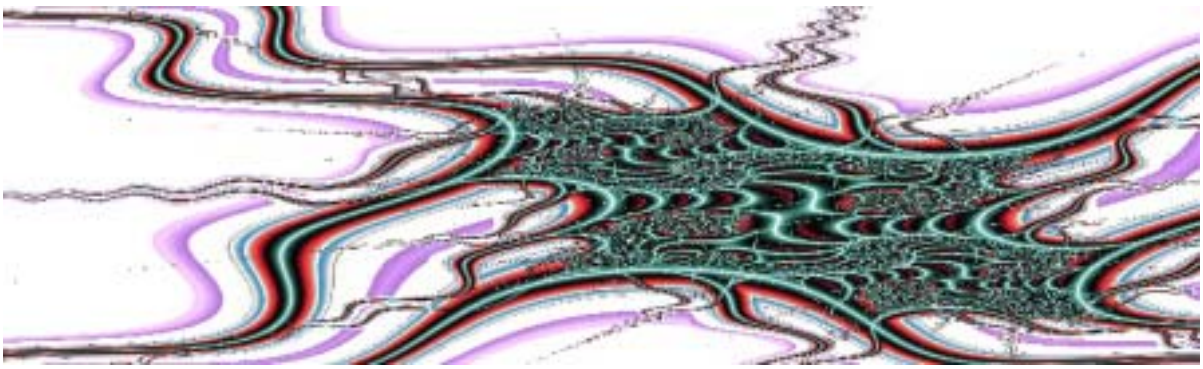

Classroom Chaos 1

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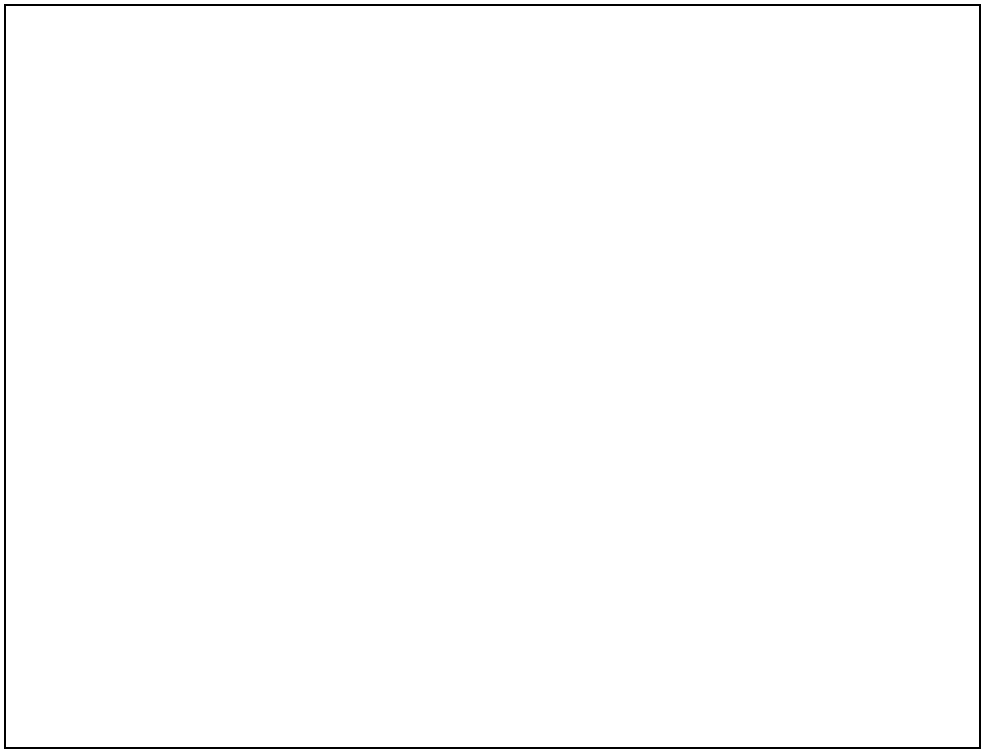
I. The Chaos Game

1. Place a dot on each of the edges of the box below so that the dots form the vertices of a four-sided convex polygon. Do not place the dots in a rectangular pattern! Connect these dots.
2. Label the four corners A, B, C, and D
3. Randomly draw a point inside the polygon. This is your initial point.
4. Flip two coins in a way in which you can clearly distinguish a right and left coin. Now draw a new point halfway between your initial point and one of the vertices based on the following head-tail result:

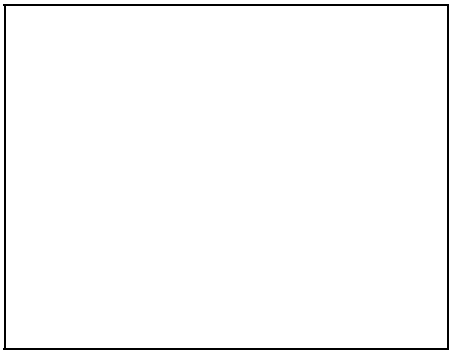
   HH - A HT - B TH - C TT - D

   Repeat step 4 thirty times.

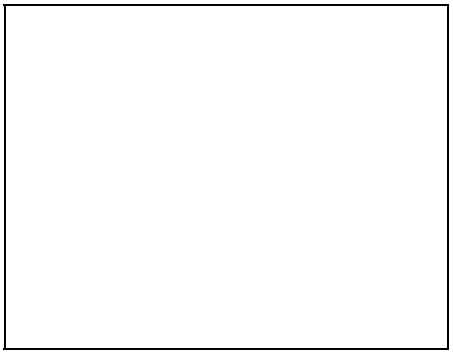


Questions

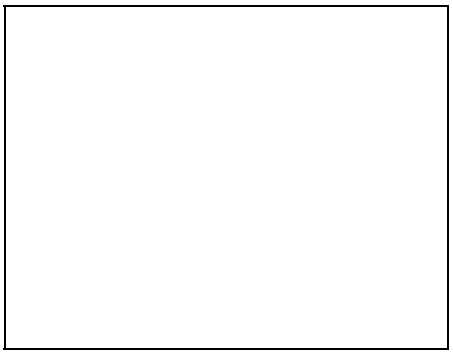
1. What do you think the picture in your polygon would look like if you repeated step 4 above a billion times? Draw a mini version of your figure.



2. Would your answer change if you had started with a different initial point? Explain why or why not. If you think that it will change, sketch an illustrative figure. Be sure to indicate your new initial point.



3. Would your answer change if you had started with a different 4-sided polygon? Explain why or why not. If not, sketch an illustrative figure.



II. RANFRAC2: The Square

1. Set up Ranfrac2:
   - 4- Sided Figure, No Dormant Nodes (Use F5 key to change from default triangle)
   - Boring (this is the default setting)
   - Rule 0 (also the default)

Warning: Do not "change the rules" (*hit the F8 key*) during this activity!!

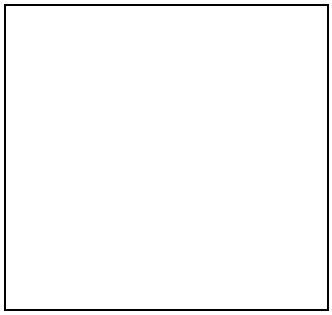
2. In Single-Dot mode, play the Chaos Game with your square. What will the figure look like if a billion dots are placed randomly within your square in the boring mode? (Please sketch.)

3. Switch to Auto-Dot Mode, and play with the speed controls. Is your prediction from #2 verified? If not, how does it differ fro what you see?

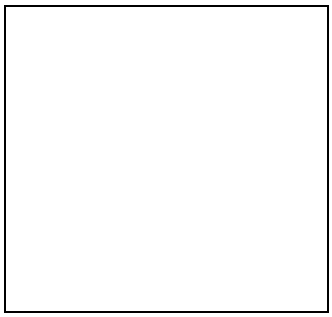
4. Predict what the figure would look like if the TARGET coloring scheme is used. Describe this in words and draw a sketch.

5. Switch to the TARGET coloring scheme. What do you observe? Does it match your prediction from #4?

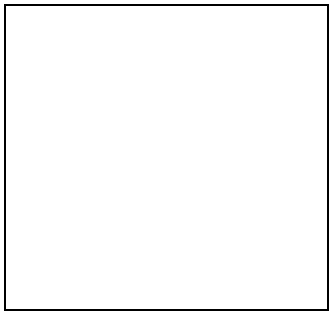
6. Predict what the figure would look like if the CLONE coloring scheme is used.

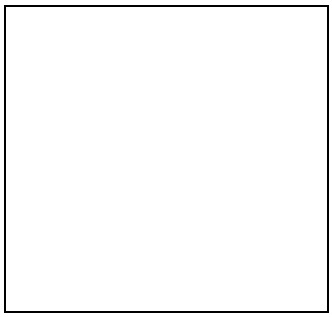


7. Try the CLONE mode. What do you observe? How does it compare with your predictions from #6?



8. Predict the CLONER and CLONEST schemes patterns, then try them.



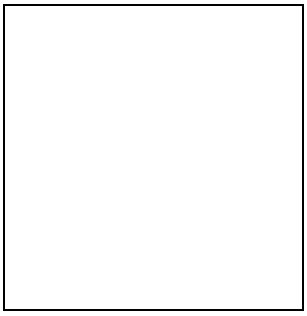


III. RANFRAC2: The Triangle

1. Set up Ranfrac2:
   - 3- Sided Figure, No Dormant Nodes (Use F5 key to change from default triangle)
   - Boring (this is the default setting)
   - Rule 0 (also the default)

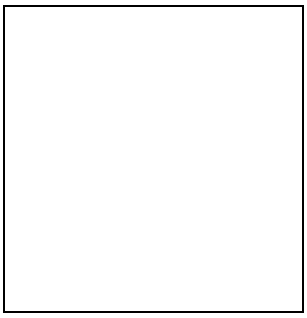
Warning: Do not "change the rules" (*hit the F8 key*) during this activity!!

2. In Single-Dot mode, play the Chaos Game with your triangle. What will the figure look like if a billion dots are placed randomly within your square in the boring mode? (Please sketch.)



3. Switch to Auto-Dot Mode, and play with the speed controls. Is your prediction from #2 verified? If not, how does it differ fro what you see?

4. Predict what the figure would look like if the TARGET or CLONE coloring scheme is used. Draw a sketch of one these predictions, then try it out using RANFRAC2.

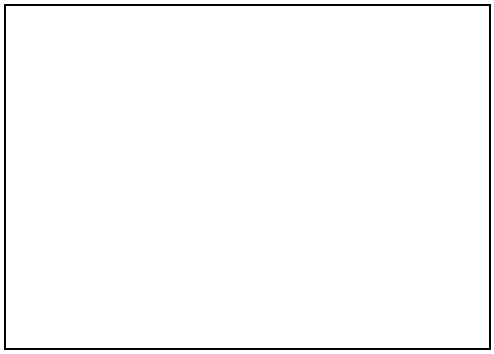


5. Try starting and stopping several times to se if you can track the initial point. Does the final figure depend on the initial point? How does this compare with your answer to Question # in the Chaos Game section?

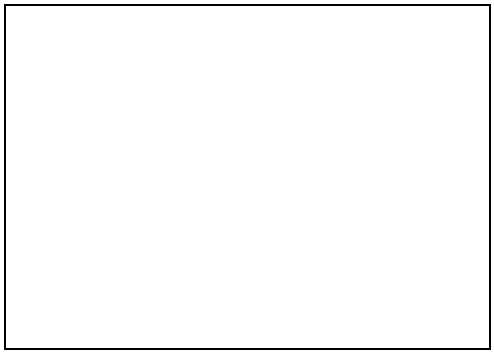
IV. Understanding the Chaos Game: Prediction

1. Use Ranfrac2 to investigate the images obtained for regular polygons that are 5 - 9 sided. Your goal is to "understand" what you see to the extent that you can **predict** what will happen for any polygon. You may find that different coloring schemes will help you "understand" what is happening. Make conjectures and try them out!! Once you feel that you can make accurate predictions, try them out on your neighbor(s).

2. Go back to Part I (The Chaos Game) and redraw (if necessary) what you would expect to see if you could enter your irregular polygon in RANFRAC2.



3. Approximate your original Chaos Game figure in RANFRAC2 though a judicious choice of an n-sided figure, with n-4 dormant nodes. Sketch what you obtain for your figure. Do you think you "understand" the Chaos Game?



IV. Changing the Rules

Experiment with different rules, coloring schemes, number of dormant nodes, ...

Some favorites:

- 3-sided figure, Rule 1
- 3-sided figure, Rule 4, Clone
- 9-sided figure with differing number of Dormant nodes, Rule 4, Cloner