

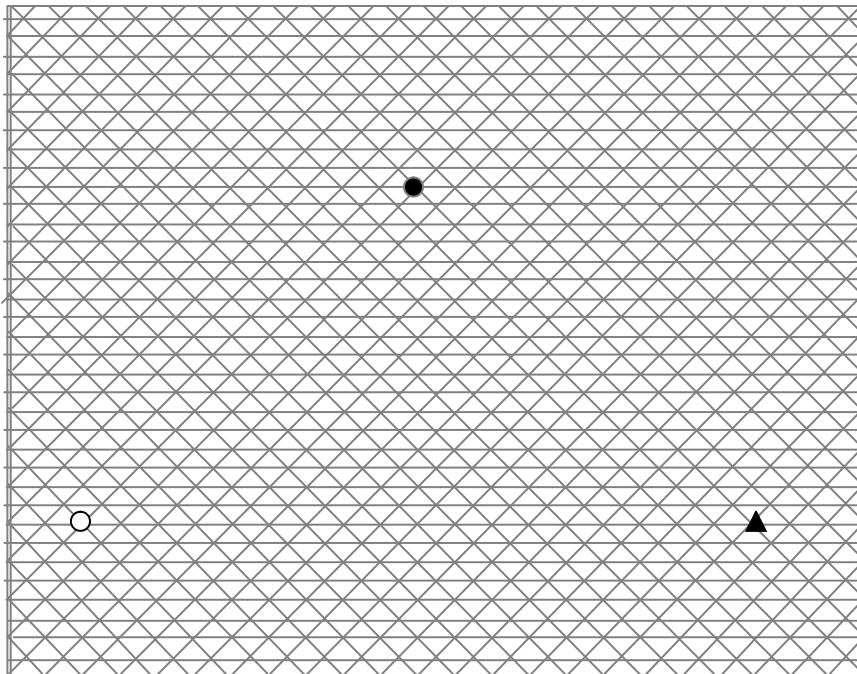
Chaos Fractal game

Overview: This is a game that is based on fractals. You'll need the triangle grid paper and a die. This is a great demonstration on how probability can be used with a game to come up with beautiful patterns.

Materials

- Three pens with different colors, possible blue, green and red
- Dice (well, really just one die that you are okay with drawing on to color-code it)
- A paper with triangular grids (refer to last pages of this lesson)

Activity: On the grid paper, mark three dots with a different color each: red, blue and green. In the sample below (since we don't have colors, just black and white) you'll find a solid triangle, a solid circle and an unshaded circle to mark the three different "colors." The dots should be the vertices of an equilateral triangle.



We need to convert the six-sided die into a die that has only three options (instead of six). Use your markers to color two sides of the die the same color. Do this for all three colors, so you've shaded two faces blue, two faces red, and two faces green.

For our demonstration, blue is the solid triangle, red is the open circle and green is the solid circle.

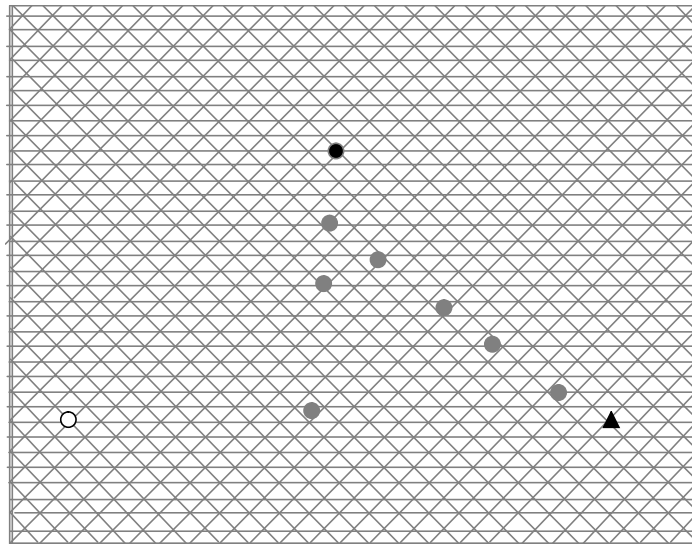
Use another color and mark a "seed point" – any point within the area bounded by the triangle. It can be anywhere – it really doesn't matter where. Just mark a spot.

Now roll the die. Suppose it lands on a blue face. Now measure out the distance (it doesn't have to be perfect – you can eyeball it) between the seed point and the blue dot and move your seed point to this new location by making a new dot (leave the original seed mark there).

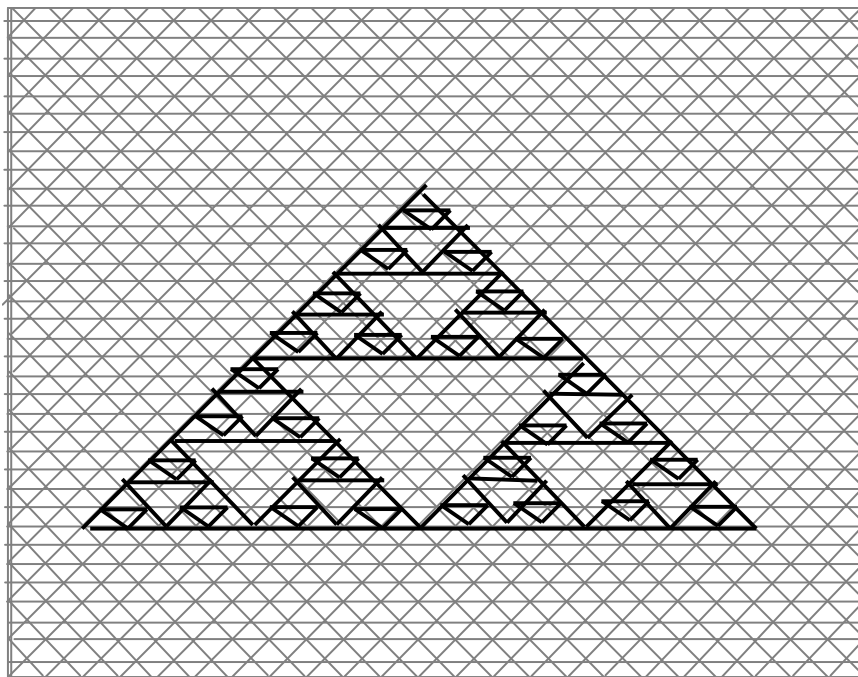
Now roll the die again. Suppose you get blue again. Now mark another spot that's halfway between your most recent dot and the blue vertex of the original triangle.

If you roll again and you get red, then you look at the distance between the red vertex (the open circle in our diagram) and the most recent mark.

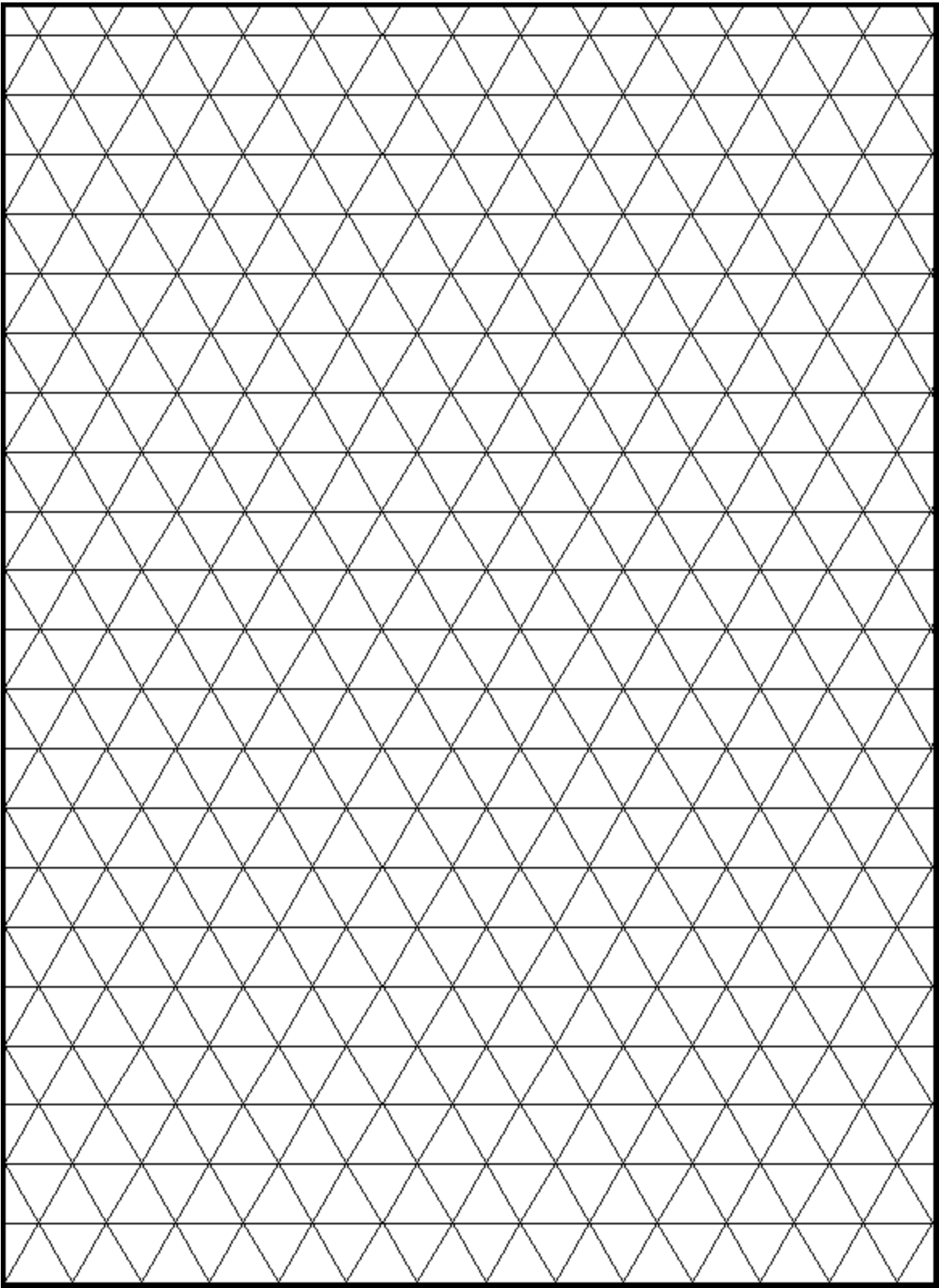
After several rolls of the die, you might get something like this:



Imagine that you roll the die 100 times, and make 100 different dots. What do you think the shape would be that the dots would make? (Hint: Think *Sierpinski* triangle!)



The chances of rolling a red are one in three, or one third. This game uses both probability and fractals in one neat application. You can color code your dots such that when you roll a red, use your red marker to make the new point on your graph. If you roll a green, mark the dot with a green marker, and so on.



Exercises

1. How many players can comfortably play the fractals game at a time?
2. How many ink pen colors are required to effectively play the game?
3. When are the first dots made on the grid?
4. What are the building units of the fractal grid that is used in the game?
5. Where specifically are the first dots placed?
6. Apart from the pens and the grid, what else is required to play the game?
7. What is the probability that at least one player will play in a given turn?
8. What is done on the die to ensure equal chances for each player?
9. In the subsequent plays, where is the dot corresponding to the player positioned?
10. What is the name of the resultant figure that results if the player goes through 100 turns?

Answers to Exercises: Chaos Fractal Game

1. 3
2. 3
3. Before rolling the die for the first time
4. Triangles
5. At the vertices of the equilateral triangle
6. Die
7. $1/3$
8. Each color painted on two faces of the die
9. Between the more recent dot and the player's first dot at the vertex of the triangle
10. Sierpinski triangle