# Lindenmayer Systems: An Exercise

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## Rendering

A metaphorical turtle draws lines on the screen, based on instructions given in a *word*.

Basic L-systems have words composed of three symbols, with the meaning noted:  
  
F move forward, while drawing a line

+ turn left by the specified angle

–  turn right by the specified angle

An *axiom*, or initial word, is specified. Based on *production rules*, symbols (also known as characters) are replaced in the axiom to produce a new word. A word can be re-written several times – by repeatedly applying the production rules to replace symbols.

To actually draw a figure on screen using an L-system, a computer program requires the following information:

*length* The length of the line segments used to draw the axiom.

*reduction* The factor by which to reduce the initial line segment length  
 each time a word is re-written.

*x* The initial horizontal position of the turtle on screen.

*y* The initial vertical position of the turtle on screen.

*direction* The initial direction that the turtle is facing; in degrees.  
 *angle* The angle by which the turtle will turn left or right; in degrees.

*axiom* The initial word (describes what turtle would draw without   
 any symbol replacements based on production rules).

*rules* A list of rules that describe how symbols will be replaced.

*n* The number of times that a word must be re-written to  
 produce the desired output.

## Exercise

Here are the details required to render an L-system that produces a classic fractal:  
  
 *length* 300

*reduction*   
 So, after one level of replacement, line segment length  
 would be   
 *x* 100

*y* 400

*direction* 0

*angle* 60

*axiom* F++F++F

*rules* F=F–F++F–F

*n* 3

Given the details above, fill in the table on the next page.

What is the word after each re-write?

How would the word be rendered?

| **axiom** | **renders as…** |
| --- | --- |
| F++F++F |  |

| **number of times production rules have been applied to re-write word** | **word** | **renders as…** |
| --- | --- | --- |
| **1** |  |  |
| **2** |  |  |
| **3** |  |  |

## References

Prusinkiewicz, Przemyslaw, and Aristid Lindenmayer. *The Algorithmic Beauty of Plants.* New York: Springer-Verlag, 1990. Print.

*Note:*

The above-referenced book is available online, free, in its complete form, at this address:  
  
<http://algorithmicbotany.org/papers/#abop>