Randomness

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Start With Something We’ve Seen Before

```java
void setup()
{
    size( 800, 600 );
    colorMode( RGB );
    background( 200, 200, 255 );
    stroke( 0, 0, 255 );
    strokeWeight( 4. );
    fill( 255, 50, 50 );
    noFill( );
}

void draw()
{
    beginShape();
    vertex( 100, 100 );
    vertex( 100, 400 );
    vertex( 200, 400 );
    vertex( 300, 300 );
    vertex( 400,  50 );
    endShape();
}
```
Pure Randomness is Pretty Jarring

```c
void draw()
{
    background(200, 200, 255);
    beginShape();
    for(int x = 0; x < width; x = x + 5)
    {
        int y = int(random(0, height));
        vertex(x, y);
    }
    endShape();
}
```
A Better Approach – Add a Random Number to the Current Value

```c
void draw( )
{
  background( 200, 200, 255 );
  int y = height / 2;
  beginShape( );
  for( int x = 0; x < width; x = x + 5 )
  {
    int dy = int( random( -height/10, height/10 ) );
    y = y + dy;
    vertex( x, y );
  }
  endShape( );
}
```
Computer Graphics Noise

- The built-in `noise()` function is a smoothly-changing sequence of values.
- It returns values from 0. to 1.
- It is centered around 0.5, i.e., the midline.
- It can be spread out (made smoother) by making the argument smaller.
- It can be compressed (made more jagged) by making the argument larger.
- It is **Coherent** in that the noise value at one point is close to the noise value at the next point.
- Setting `noiseSeed()` makes it **Repeatable** in that the same input *always* gives the same output.
Noise Octaves Create More Detail

A *Noise Octave* is another noise wave with lower amplitude (height) and higher frequency (jagginess). We add octaves together to get a combination of smoothness and jagginess.
float NoiseFactor = 200.; // larger to make the noise gentler
int NoiseSeed = 22019; // start the random number sequence
int MinOctaves = 1;
int MaxOctaves = 8;

void setup()
{
    size(800, 600);
colorMode(RGB);
nofill();
noiseSeed(NoiseSeed);
}
```cpp
void draw( )
{
  background( 200, 200, 255 );
  stroke( 128, 0, 0 );
  strokeWeight( 1. );
  beginShape( );
    vertex( 0,     height/2 );
    vertex( width, height/2 );
  endShape( );

  for( int octaves = MinOctaves; octaves <= MaxOctaves; octaves = octaves*2 )
  {
    noiseDetail( octaves );
    int green = int( map( octaves, MinOctaves, MaxOctaves, 0, 255 ) );
    stroke( 255, green, 0 );
    beginShape( );
    for( int x = 0; x < width; x = x + 5 )
    {
      int y = ( height / 2 ) + int( ( height ) * ( noise( x / NoiseFactor ) - 0.5 ) );
      vertex( x, y );
    }
    endShape( );
  }
```

---

**Noise Octaves Add More Detail**

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*[Image: Noise-detail.png]*
int y = (height / 2) + int((height) * (noise(x / NoiseFactor) - 0.5));

- Gives us 0. to 1.
- Gives us -0.5 to +0.5
- Gives us -height/2. to +height/2.
- Gives us 0. to height

Noise Octaves Add More Detail

0.

height
float NoiseFactor = 200.;  // larger to make the noise gentler
int NoiseSeed = 22019;  // start the random number sequence

void setup( )
{
    size( 800, 800 );
    colorMode( RGB );
    background( 200, 200, 255 );
    fill( 255, 255, 0 );
    stroke( 0, 0, 0 );
    noiseSeed( NoiseSeed );
    noiseDetail( 4 );
}

In draw( ):  

    if ( mousePressed )
    {
        float nx = noise( mouseX/NoiseFactor );
        float ny = noise( mouseY/NoiseFactor );
        ellipse( mouseX, mouseY, 200*nx, 200*ny );
    }
Using Noise to Affect Color

```java
float NoiseFactor = 200.;  // larger to make the noise gentler
int NoiseSeed = 22019;  // start the random number sequence

void setup()
{
  size( 800, 800 );
  colorMode( RGB );
  background( 200, 200, 255 );
  fill( 255, 255, 0 );
  stroke( 0, 0, 0 );
  noiseSeed( NoiseSeed );
  noiseDetail( 4 );
}

In draw():

if ( mousePressed )
{
  float nx = noise( mouseX/NoiseFactor );
  float ny = noise( mouseY/NoiseFactor );
  int red  = int( nx*255. );
  int green = int( ny*255. );
  fill( red, green, 0. );
  ellipse( mouseX, mouseY, 100, 100 );
}
```
Using 2D Noise to Affect Color

float NoiseFactor = 200.;   // larger to make the noise gentler

void setup() {
    size( 600, 600 );
    colorMode( RGB );
    background( 200, 200, 255 );
    fill( 255, 255, 0 );
    stroke( 0, 0, 0 );
    noiseDetail( 4 );
}
Using 2D Noise to Affect Color

`void draw( )
{
    for( int x = 0; x < width; x++ )
    {
        for( int y = 0; y < height; y++ )
        {
            noiseSeed(    0 );
            int red = int( 255.*noise( x/NoiseFactor, y/NoiseFactor ) );
            noiseSeed( 1000 );
            int green = int( 255.*noise( x/NoiseFactor, y/NoiseFactor ) );
            noiseSeed( 2000 );
            int blue = int( 255.*noise( x/NoiseFactor, y/NoiseFactor ) );
            stroke( red, green, blue );
            point( x, y );
        }
    }
}

//noLoop( );
//saveFrame( "ColorClouds.png" );

Here are some fun things to try (make the window size smaller first!):
- What happens if you make NoiseFactor larger? Smaller?
- What happens if you only stroke with (red, green, 0.)?
- What if you only use red and blue? Green and blue?