

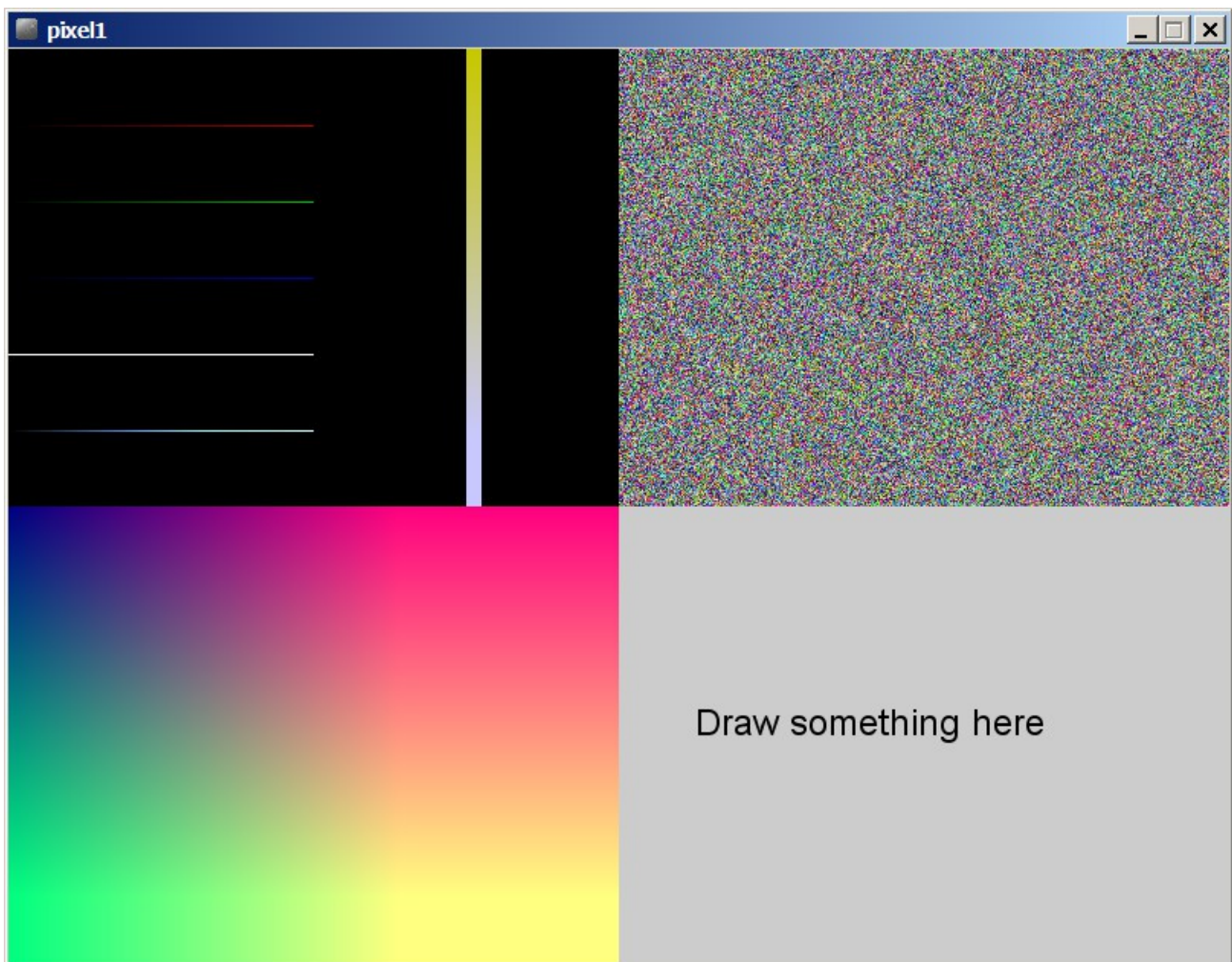
Manipulating Individual Pixels

A computer screen draws pictures by changing individual **PIXELS** on the screen. Each pixel is a small dot, powered by a **transistor**. A typical screen might be 1280 pixels wide and 800 pixels high. Other common sizes (resolution) are:

- **VGA 1024 x 768**
- **Macbook 1280 x 800**
- **WVGA 1366 x 768**
- **HD 1920 x 1080**
- **Smart Phone 480 x 800**

We notice immediately that there are LOTS of pixels on the screen. For example, 1280 x 800 is approximately 1 million pixels.

To manipulate a million pixels would require lots of Java commands - unless we use **LOOPS**. That means repetition - the computer automatically does the same thing over and over again, maybe doing the same **TRANSFORMATION** to every pixel. These are done one at a time, but they don't need to be programmed one command at a time.



The program on the next page drew the image(s) above.

```

PImage img;

void setup() {
  size(800,600);
  img = createImage(400,300,RGB);
  noLoop();
}

void draw()
{ img.loadPixels();          // creates the img.pixels[] array

  for(int y = 0; y < 300; y = y+1)
  {
    img.pixels[y*400 + 300] = color(200,200, y );
    img.pixels[y*400 + 301] = color(200,200, y );
    img.pixels[y*400 + 302] = color(200,200, y );
    img.pixels[y*400 + 303] = color(200,200, y );
    img.pixels[y*400 + 304] = color(200,200, y );
    img.pixels[y*400 + 305] = color(200,200, y );
    img.pixels[y*400 + 306] = color(200,200, y );
    img.pixels[y*400 + 307] = color(200,200, y );
    img.pixels[y*400 + 308] = color(200,200, y );
    img.pixels[y*400 + 309] = color(200,200, y );
  }

  for(int x = 0; x < 200; x = x+1)
  {
    img.pixels[20000+x] = color(x,0,0);
    img.pixels[40000+x] = color(0,x,0);
    img.pixels[60000+x] = color(0,0,x);
    img.pixels[80000+x] = color(255,255,255);
    img.pixels[100000+x]= color(x,2*x,3*x);
  }
  img.updatePixels();          // finalizes changes
  image(img, 0, 0);           // draws img in top-left corner
//=====
  for(int y = 0; y < 300; y = y+1)
  {
    for(int x = 0; x < 400; x = x+1)
    {
      float r = random(0,255);
      float g = random(0,255);
      float b = random(0,255);
      img.pixels[y*400 + x] = color(r,g,b);
    }
  }
  img.updatePixels();
  image(img,400,0);           // draw img in top-right corner
//=====
  for (int y = 0; y < 300; y=y+1)
  {
    for (int x = 0; x < 400; x=x+1)
    {
      img.pixels[y*400 + x] = color(x,y,128);
    }
  }

  img.updatePixels();
  image(img, 0 , 300);        // draw img in bottom-left corner

  textFont(createFont("Arial",24,true));
  fill(0);
  text("Draw something here",450,450);
}

```