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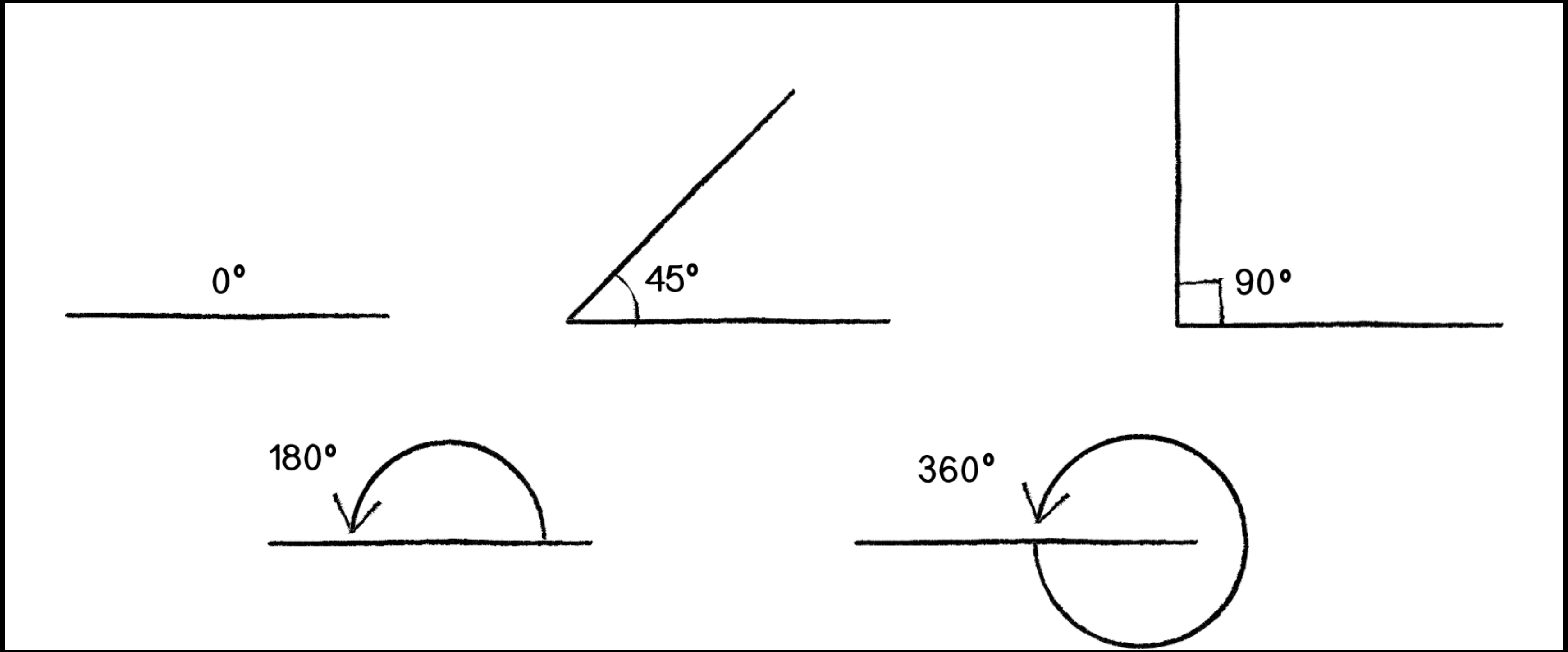
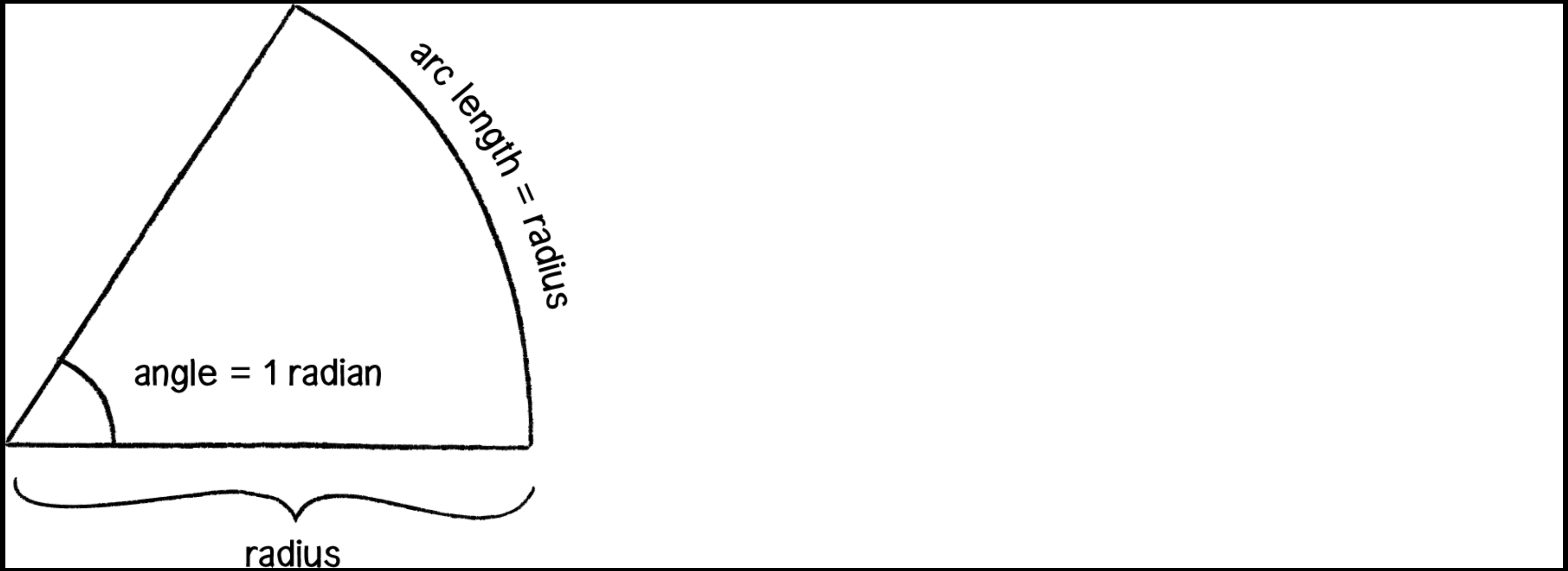
GYEONGGI SCIENCE HIGH SCHOOL

Angles



Angles



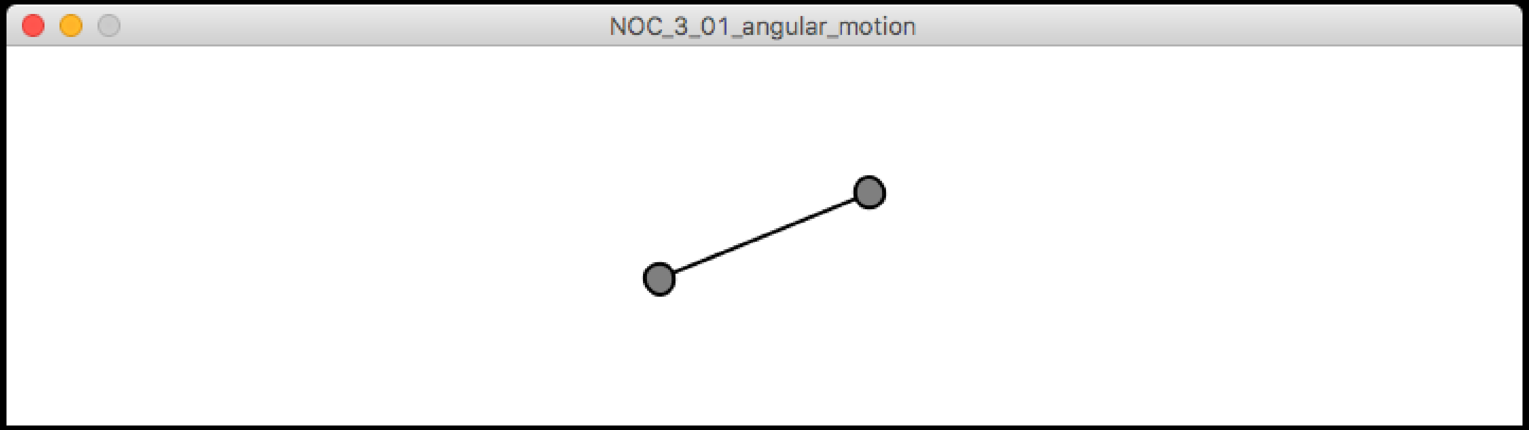
Angular Motion

- location = location + velocity
- velocity= velocity + acceleration
- angle = angle + angular velocity
- angular velocity = angular velocity + angular acceleration

Angular Motion

```
float angle = 0;
float aVelocity = 0;
float aAcceleration = 0.0001;

void setup() {
  size(800, 200);
  smooth();
}

void draw() {
  background(255);



  fill(127);
  stroke(0);

  translate(width/2, height/2);
  rectMode(CENTER);
  rotate(angle);
  stroke(0);
  strokeWeight(2);
  fill(127);
  line(-60, 0, 60, 0);
  ellipse(60, 0, 16, 16);
  ellipse(-60, 0, 16, 16);
```

Angular Motion



Angular Motion - Mover

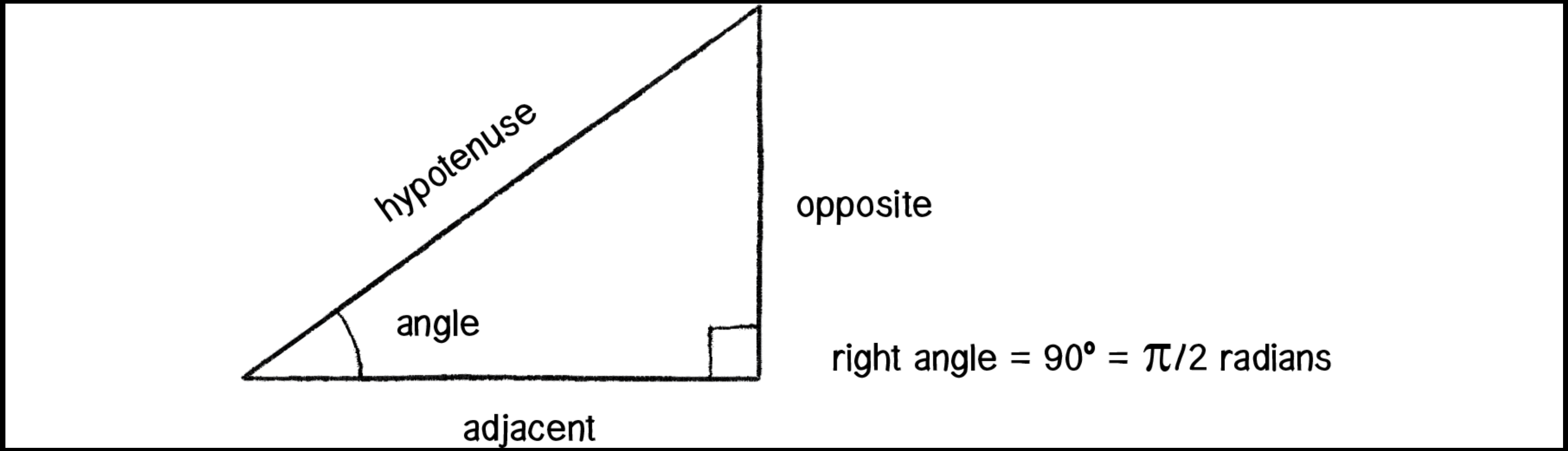
```
void update() {
        velocity.add(acceleration);
        location.add(velocity);
        aVelocity+= aAcceleration;
        angle += aVelocity;
        acceleration.mult(0);
}
```

Angular Motion - Mover

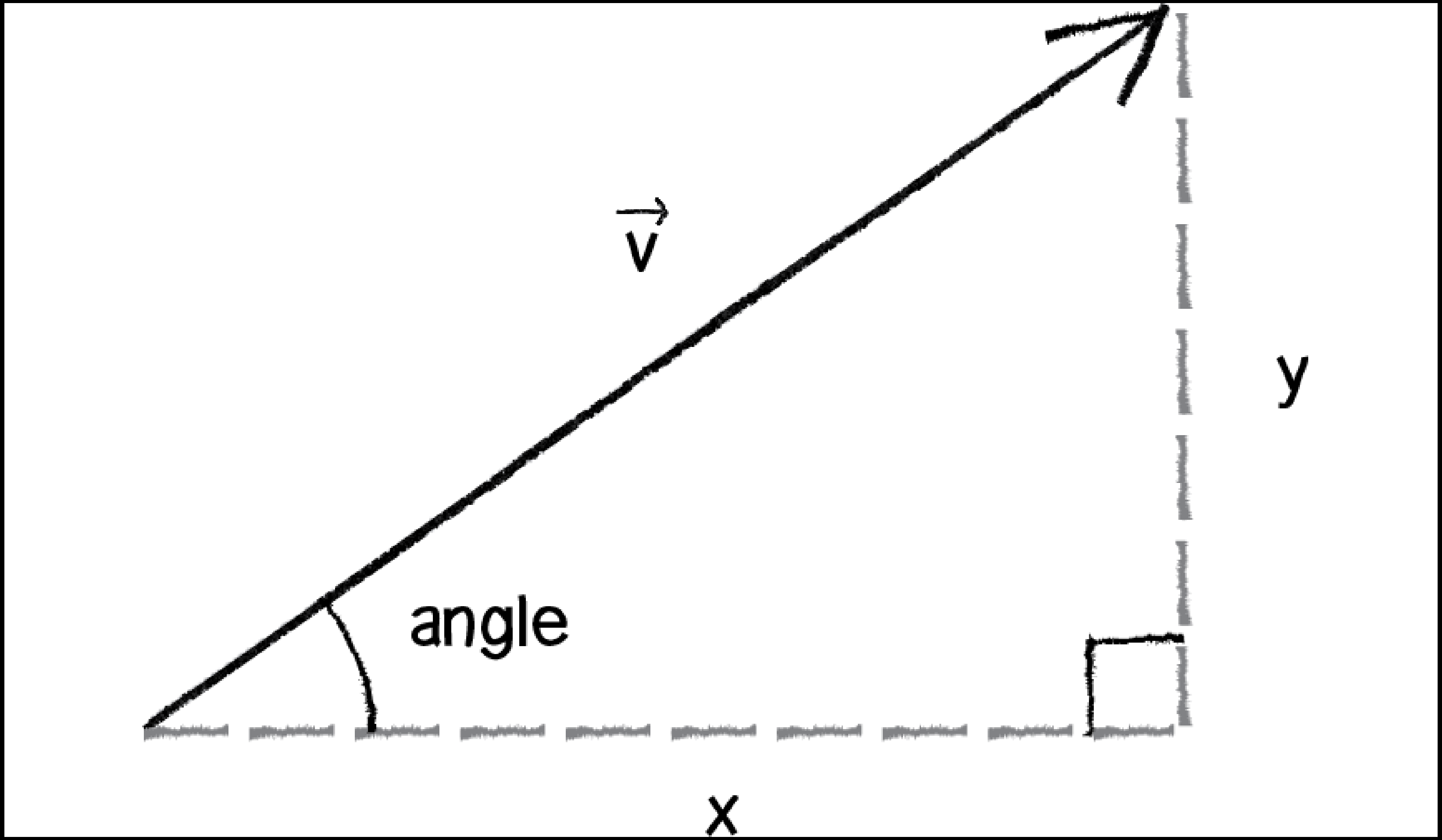
```
void display() {
	stroke(0);
	fill(175,200);
	rectMode(CENTER);
	pushMatrix();
		translate(location.x,location.y);
		rotate(angle);
		rect(0,0,mass*16,mass*16);
	popMatrix();
}
```

Canon Example

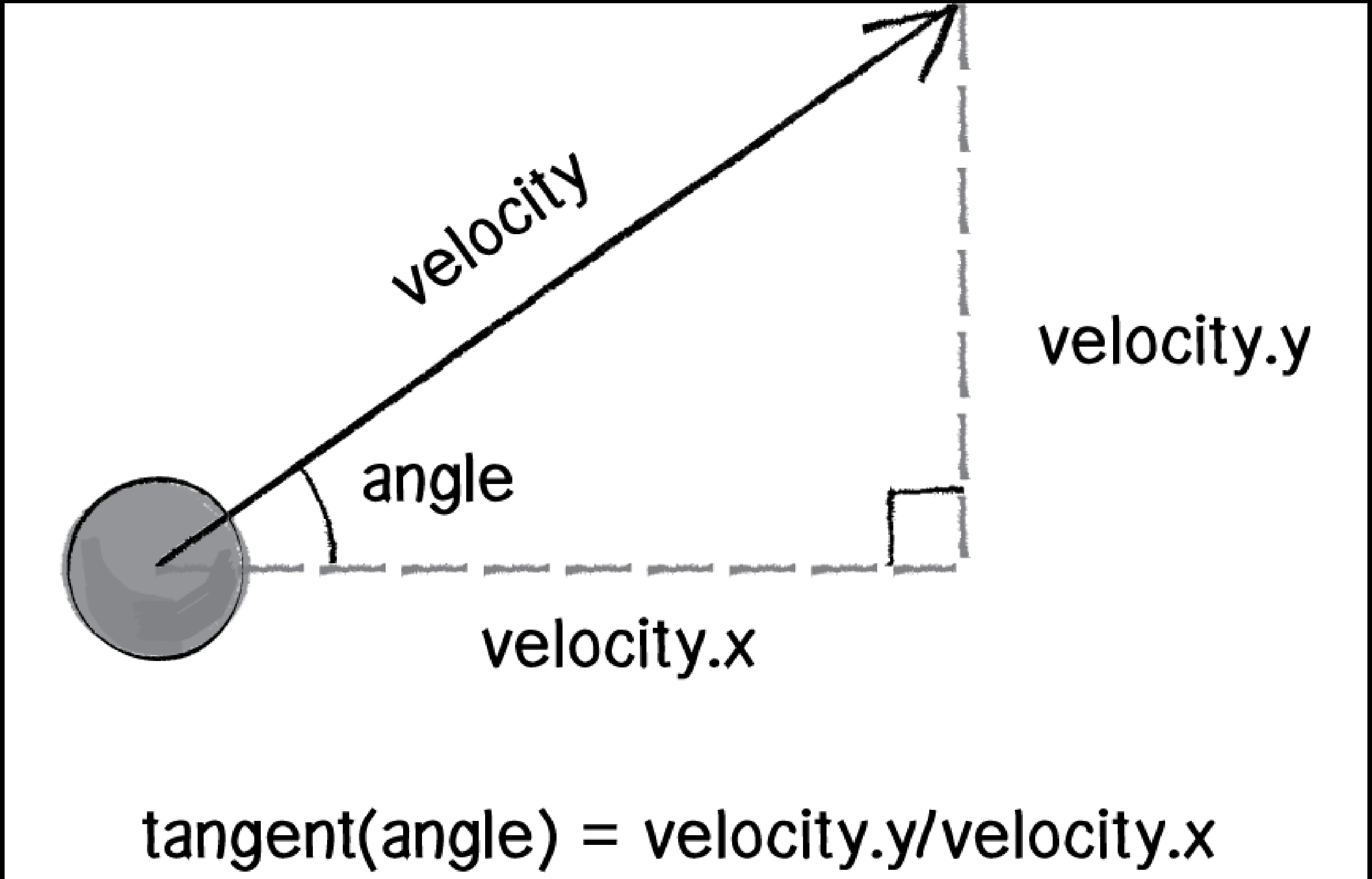
Trigonometry



Trigonometry



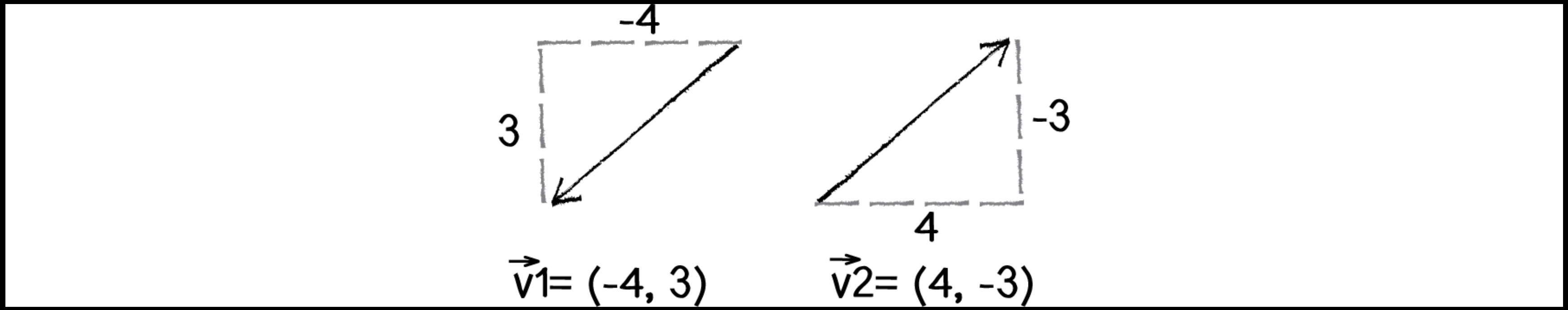
Pointing in the Direction of Movement



Pointing in the Direction of Movement

```
void display() {
    //Solve for angle by using atan().
    float angle = atan(velocity.y/velocity.x);
    stroke(0);
    fill(175);
    pushMatrix();
        rectMode(CENTER);
        translate(location.x,location.y);
        //Rotate according to that angle.
        rotate(angle);
        rect(0,0,30,10);
    popMatrix();
}
```

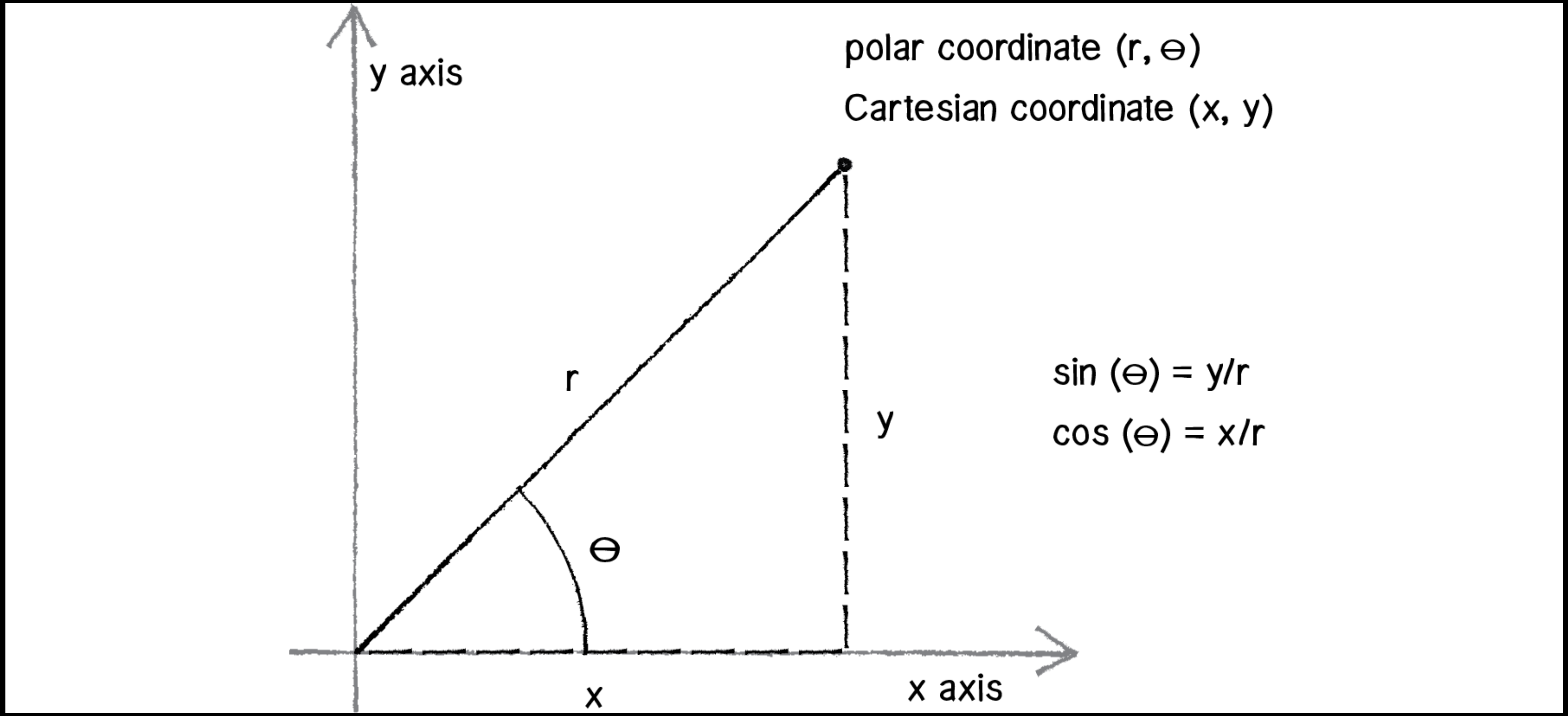
Actan Problem



Actan2 or Heading()

```
void display() {
    //Using atan2() to account for all possible directions
    float angle = atan2(velocity.y,velocity.x);
    //angle = velocity.heading();
    stroke(0);
    fill(175);
    pushMatrix();
        rectMode(CENTER);
        translate(location.x,location.y);
        //Rotate according to that angle.
        rotate(angle);
        rect(0,0,30,10);
    popMatrix();
}
```

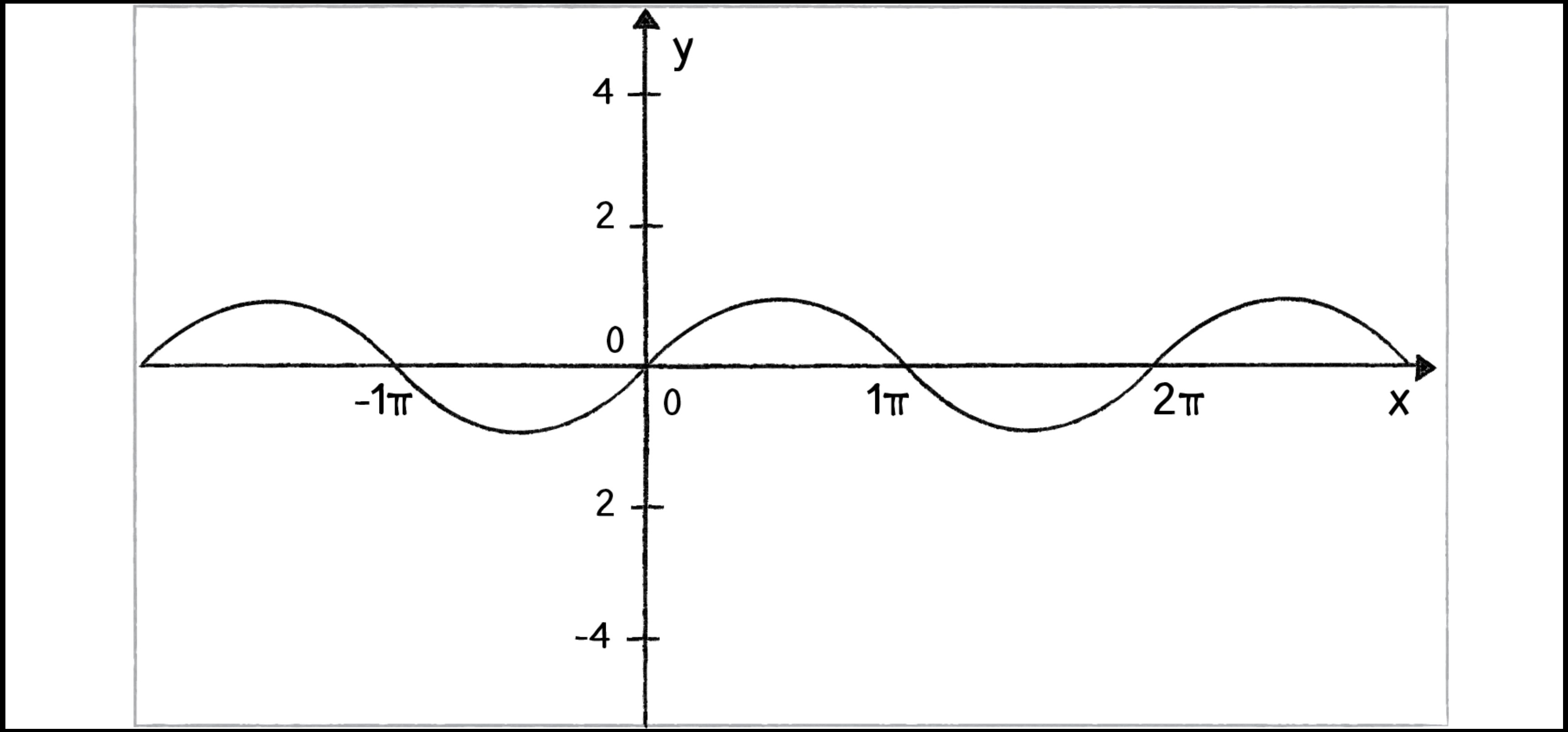
Polar vs Cartesian Coordinates



Polar to Cartesian

```
float r = 75;
float theta = PI / 4;
//Converting from polar (r,theta) to //Cartesian (x,y)
float x = r * cos(theta);
float y = r * sin(theta);
```

Oscillation Amplitude and Period



Simple Harmonic Motion

```
void setup() {
size(640,360);
}
void draw() {
background(255);
float period = 120;
float amplitude = 100;
//Calculating horizontal location according to the formula for simple harmonic motion
float x = amplitude * cos(TWO_PI * frameCount/ period);
stroke(0);
fill(175);
translate(width/2,height/2);
line(0,0,x,0);
ellipse(x,0,20,20);
}
```

Simple Harmonic Motion

frameCount	frameCount / period	TWO_PI * frameCount / period
0	0	0
60	0.5	PI
120	1	TWO_PI
240	2	2 * TWO_PI (or 4* PI)
etc.		

Oscillation with Angular Veloctiy

```
float angle = 0;
float aVelocity= 0.05;
void setup() {
size(640,360);
}
void draw() {
background(255);
float amplitude = 100;
float x = amplitude * cos(angle);
//Using the concept of angular velocity to increment an angle variable
angle += aVelocity;
ellipseMode(CENTER);
stroke(0);
fill(175);
translate(width/2,height/2);
line(0,0,x,0);
ellipse(x,0,20,20);
}
```

Waves

Waves

- 여러 개의 원을 나열하고 진동
- float angle = 0;
- float angleVel = 0.2;
- float amplitude = 100;
- 너비를 기준으로 주기를 만들어 보자.

Waves

for (int x = 0; x <= width; x += 24) {

1) Calculate the y location according to amplitude and sine of the angle.

float y = amplitude*sin(angle);

2) Draw a circle at the (x,y) location.

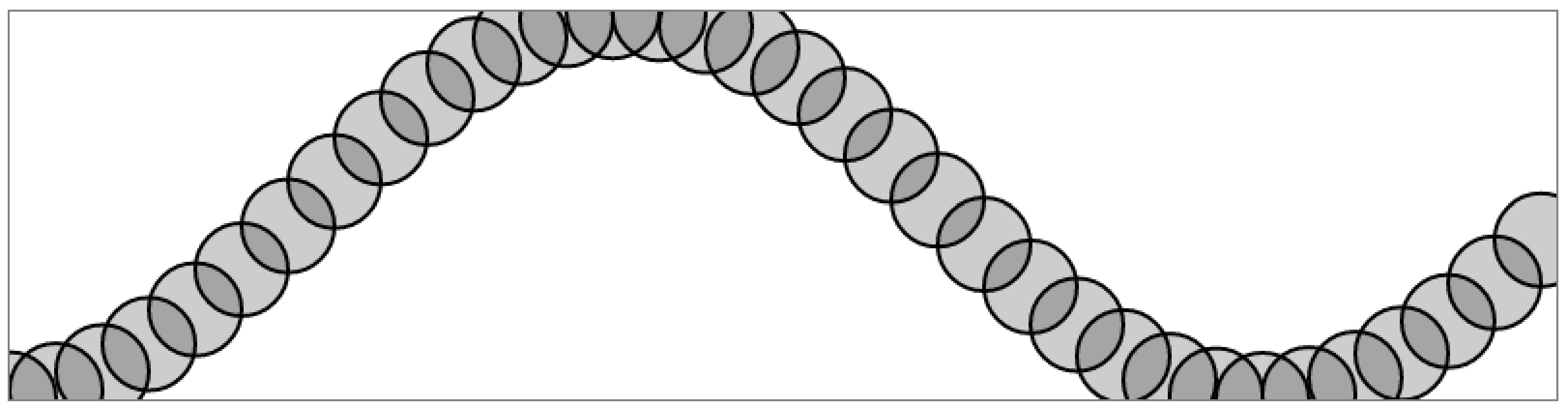
ellipse(x,y+height/2,48,48);

3) Increment the angle according to angular velocity.

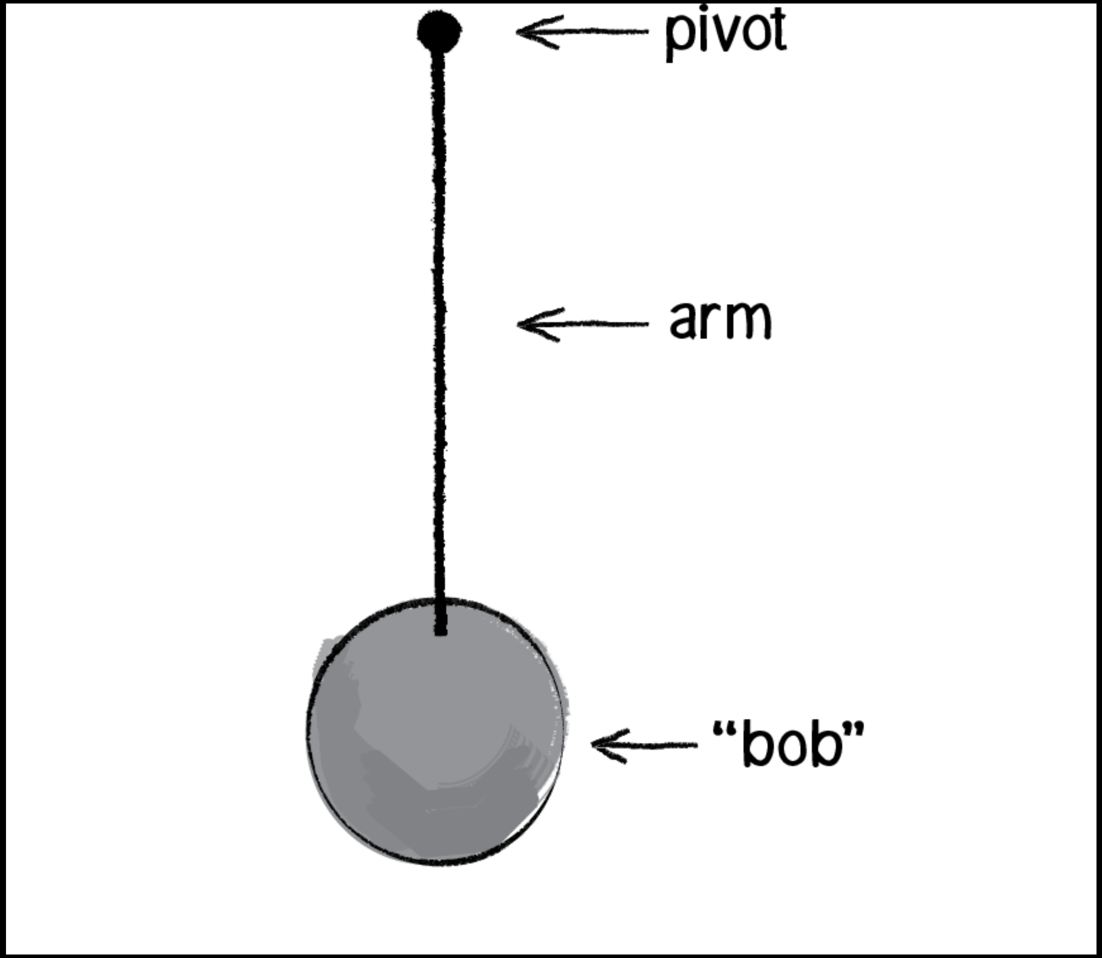
angle += angleVel;

}

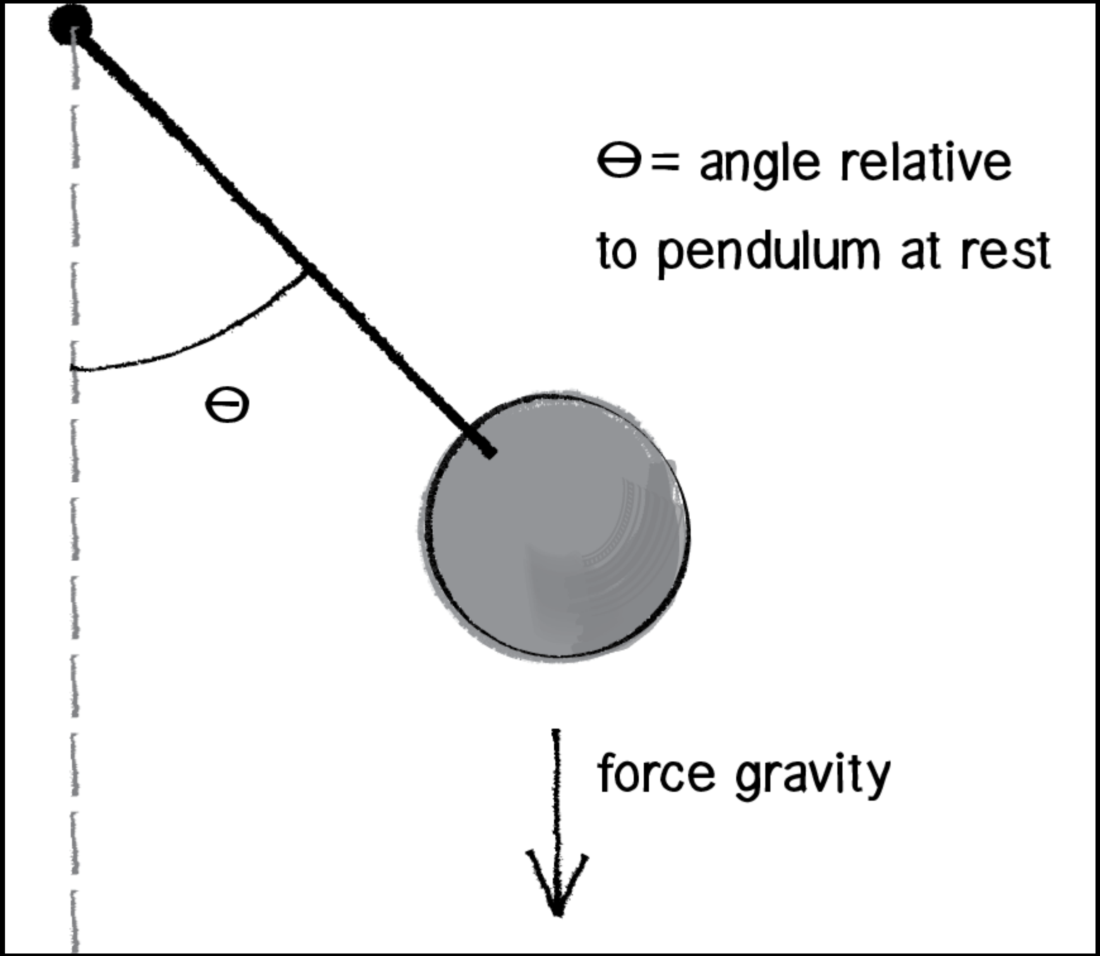
Moving Waves



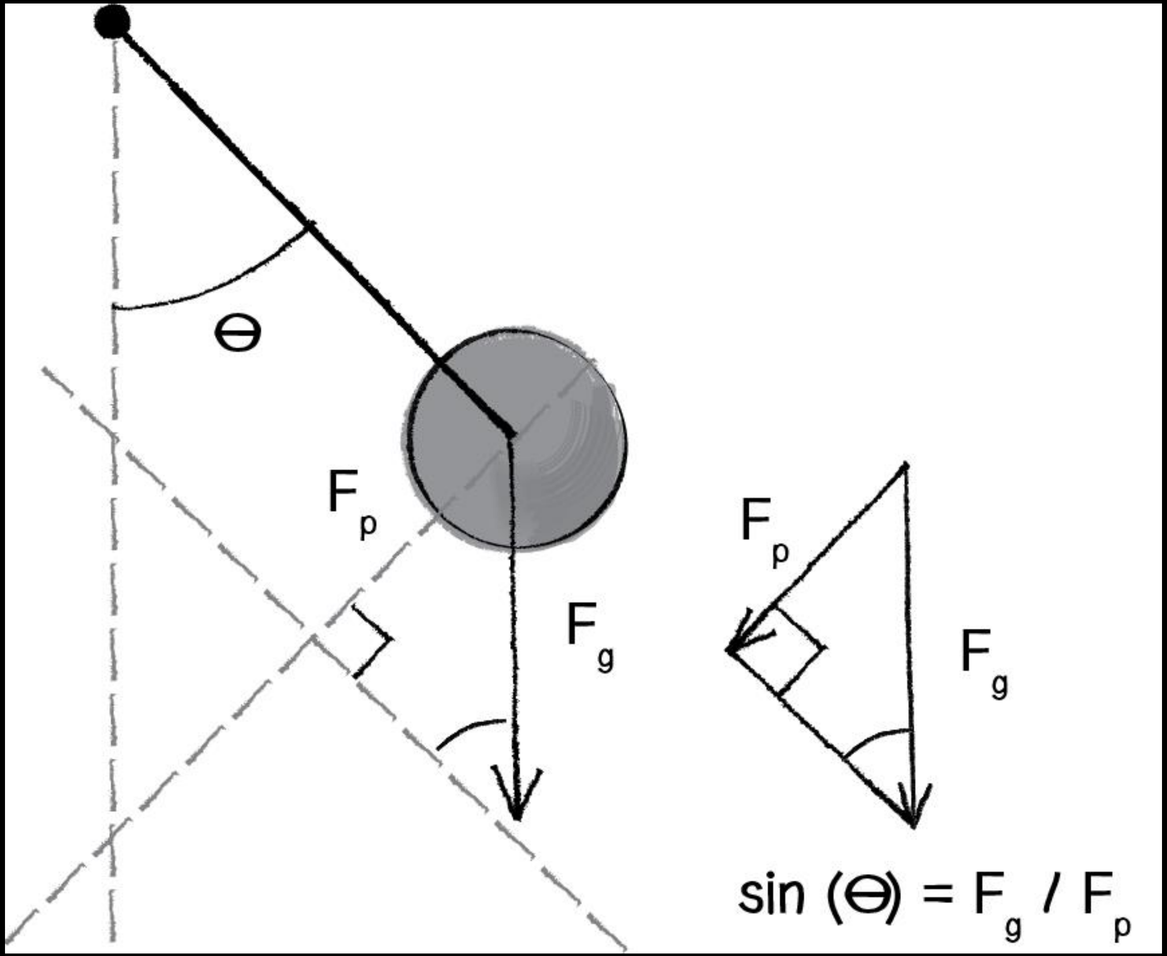
Trigonometry and Forces: The Pendulum



Trigonometry and Forces: The Pendulum



Trigonometry and Forces: The Pendulum



Trigonometry and Forces: The Pendulum

- sin(θ) = Fp/ Fg
- Fp= Fg* sin(θ)
- pendulum angular acceleration = acceleration due to gravity * sin(θ)
- angular acceleration = gravity * sin(θ)

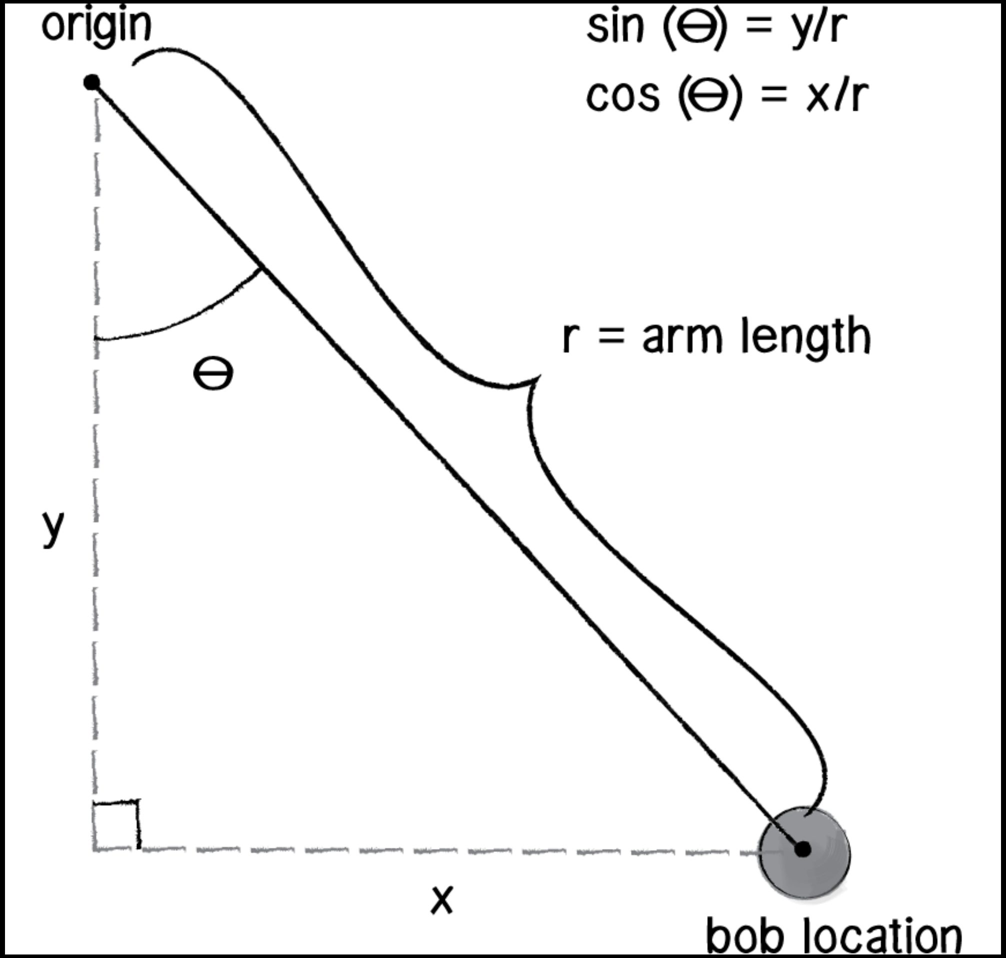
Pendulum Class

```
class Pendulum {
 float r;//Length of arm
 float angle;//Pendulum arm angle
 float aVelocity;//Angular velocity

float aAcceleration;//Angular acceleration
```

Pendulum Class

```
void update() {
  float gravity = 0.4;
  aAcceleration= -1 * gravity * sin(angle);
  aVelocity+= aAcceleration;
  angle += aVelocity;
}
```

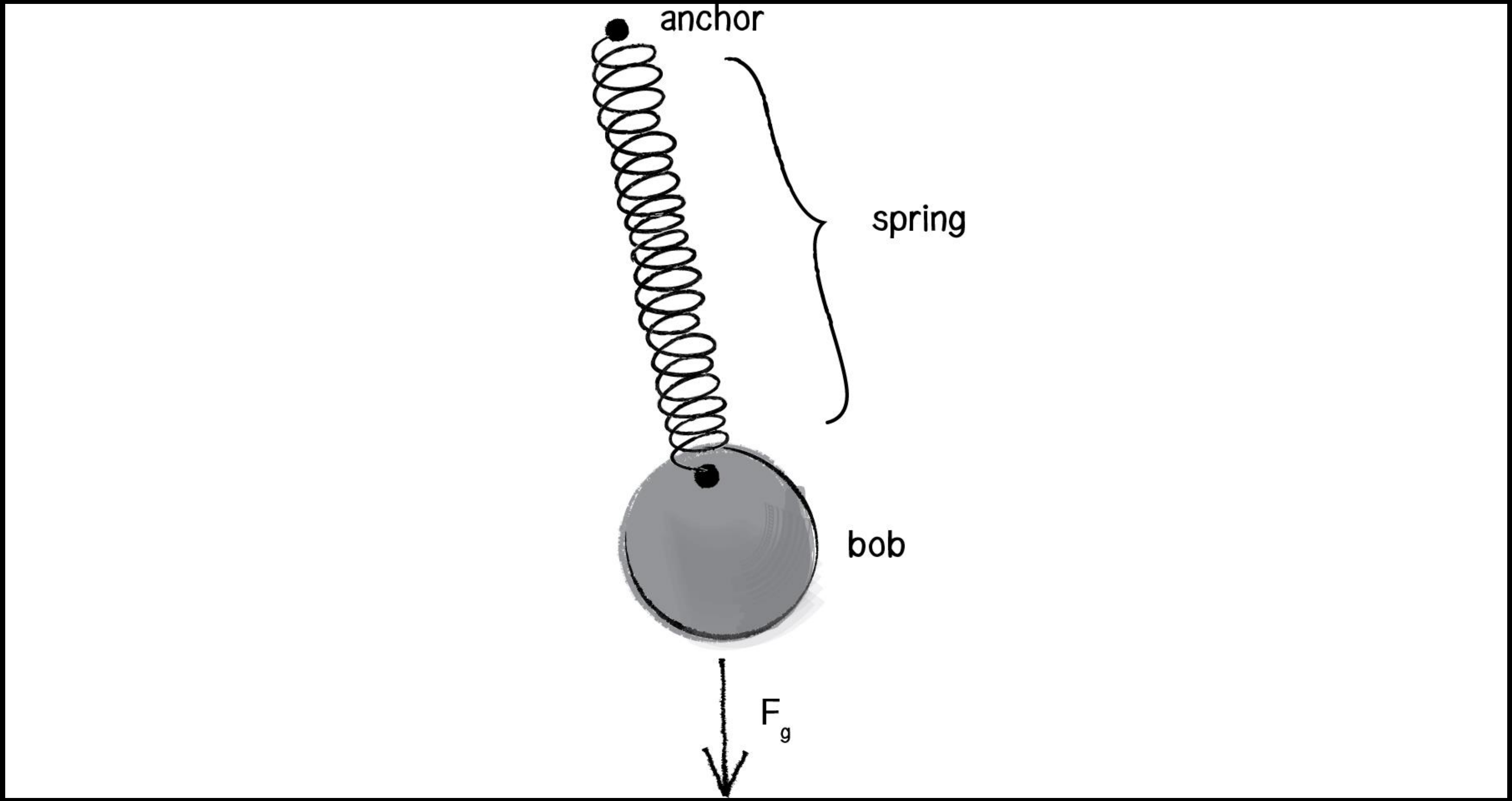
Pendulum Class



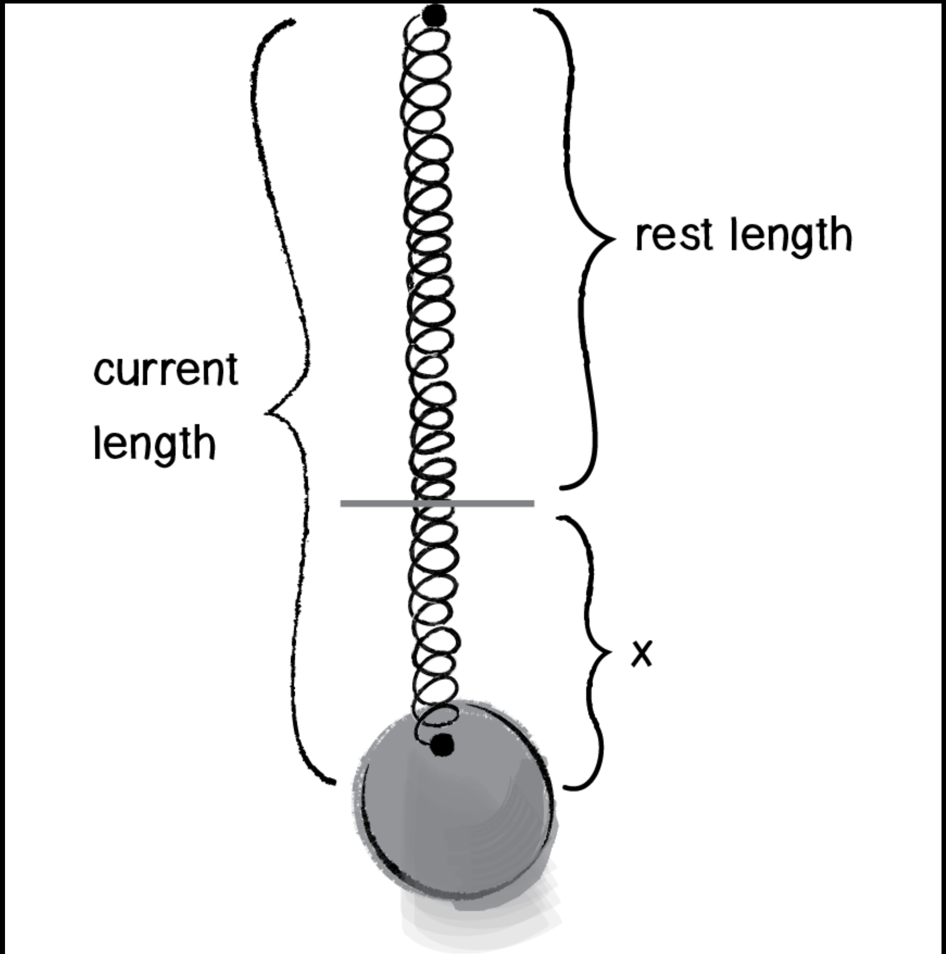
Pendulum Class

```
PVectororigin = new PVector(100,10);
float r = 125;
PVectorlocation = new PVector(r*sin(angle),r*cos(angle));
location.add(origin);
aAcceleration= (-1 * G * sin(angle)) / r;
```

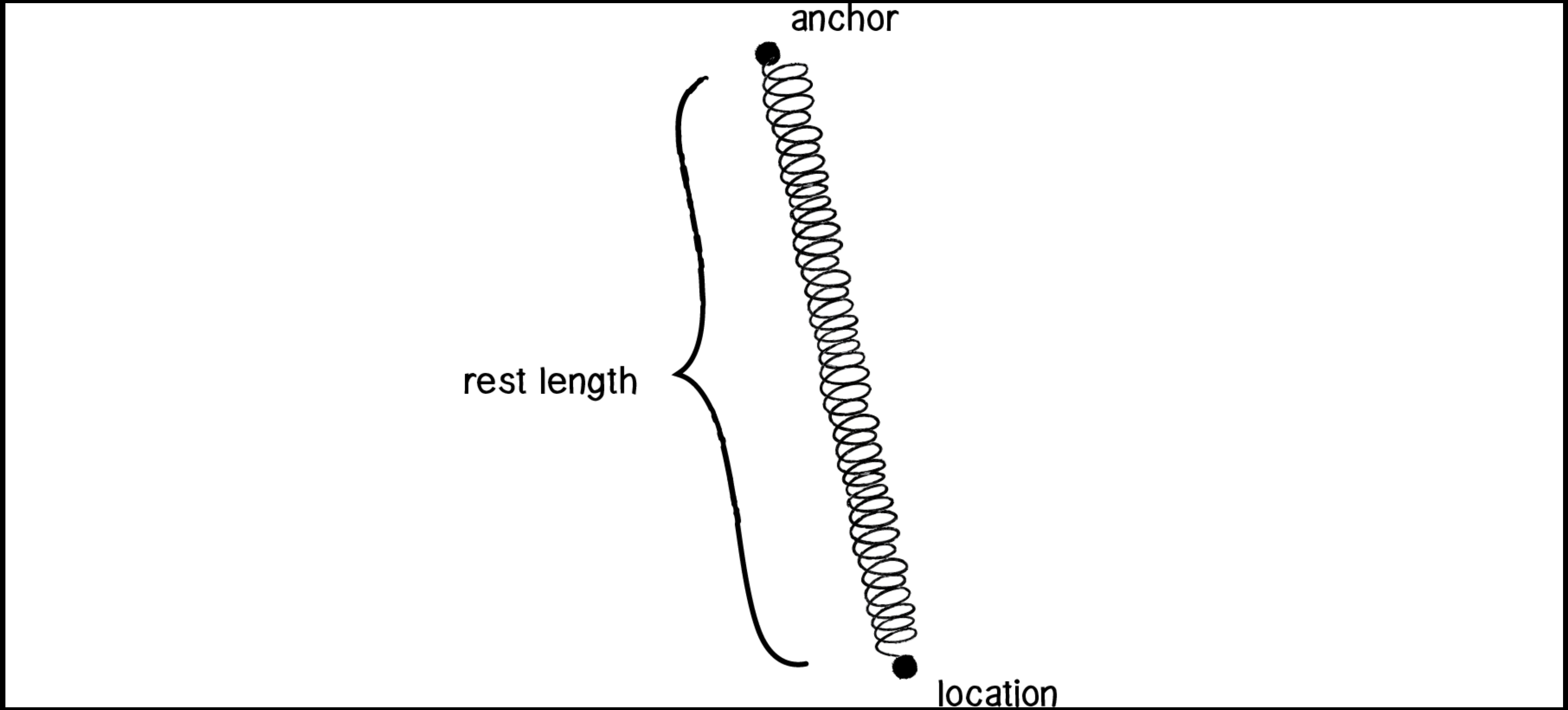
Spring Forces



Hooke's law : $F_{spring} = - k * x$



Spring Forces



Spring Forces

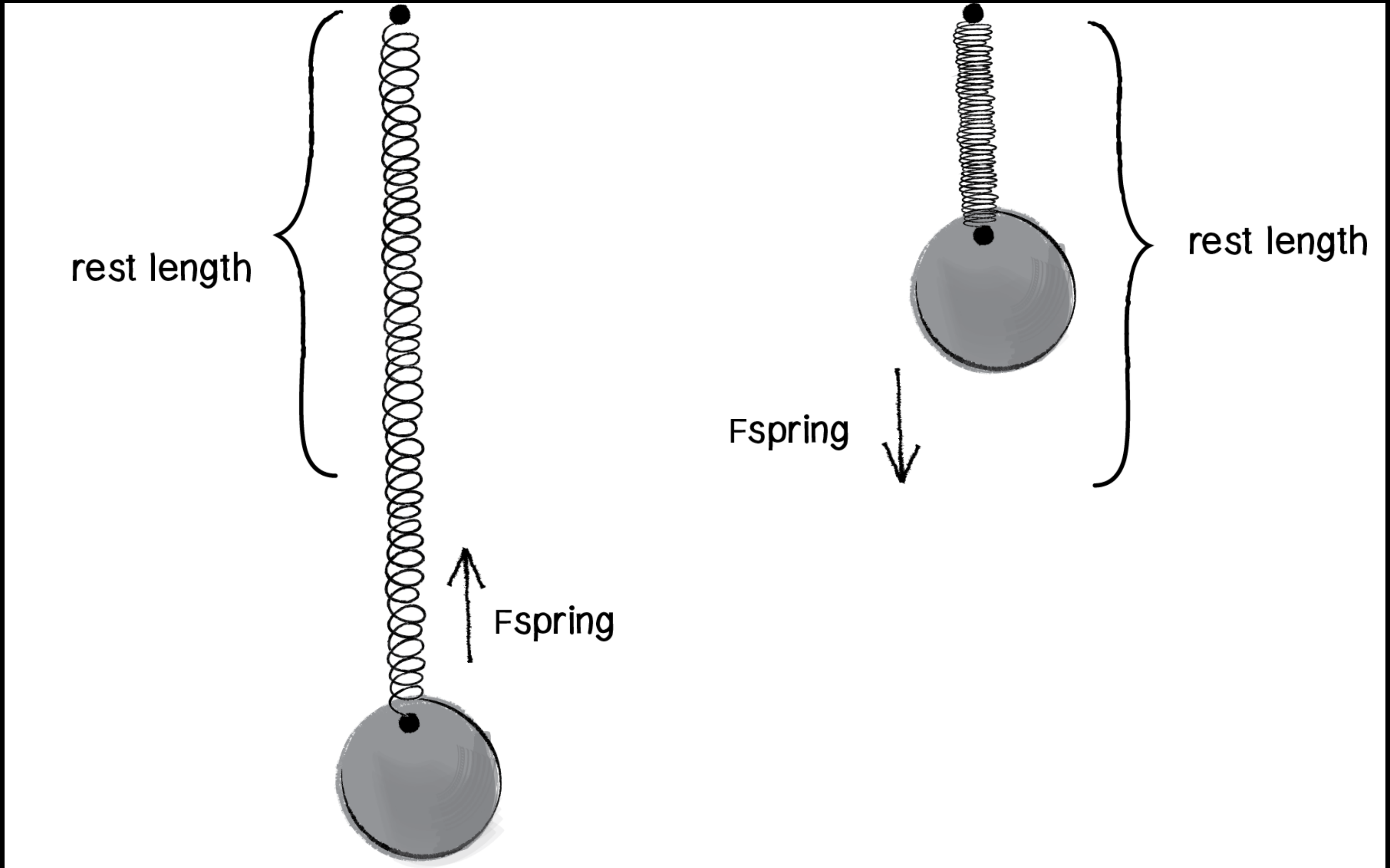
- PVector anchor;
- PVector location;
- float restLength;

- float k = 0.1

Spring Forces

- PVecto rdir= PVector.sub(bob,anchor);
- float currentLength= dir.mag();
- float x = restLength - currentLength;

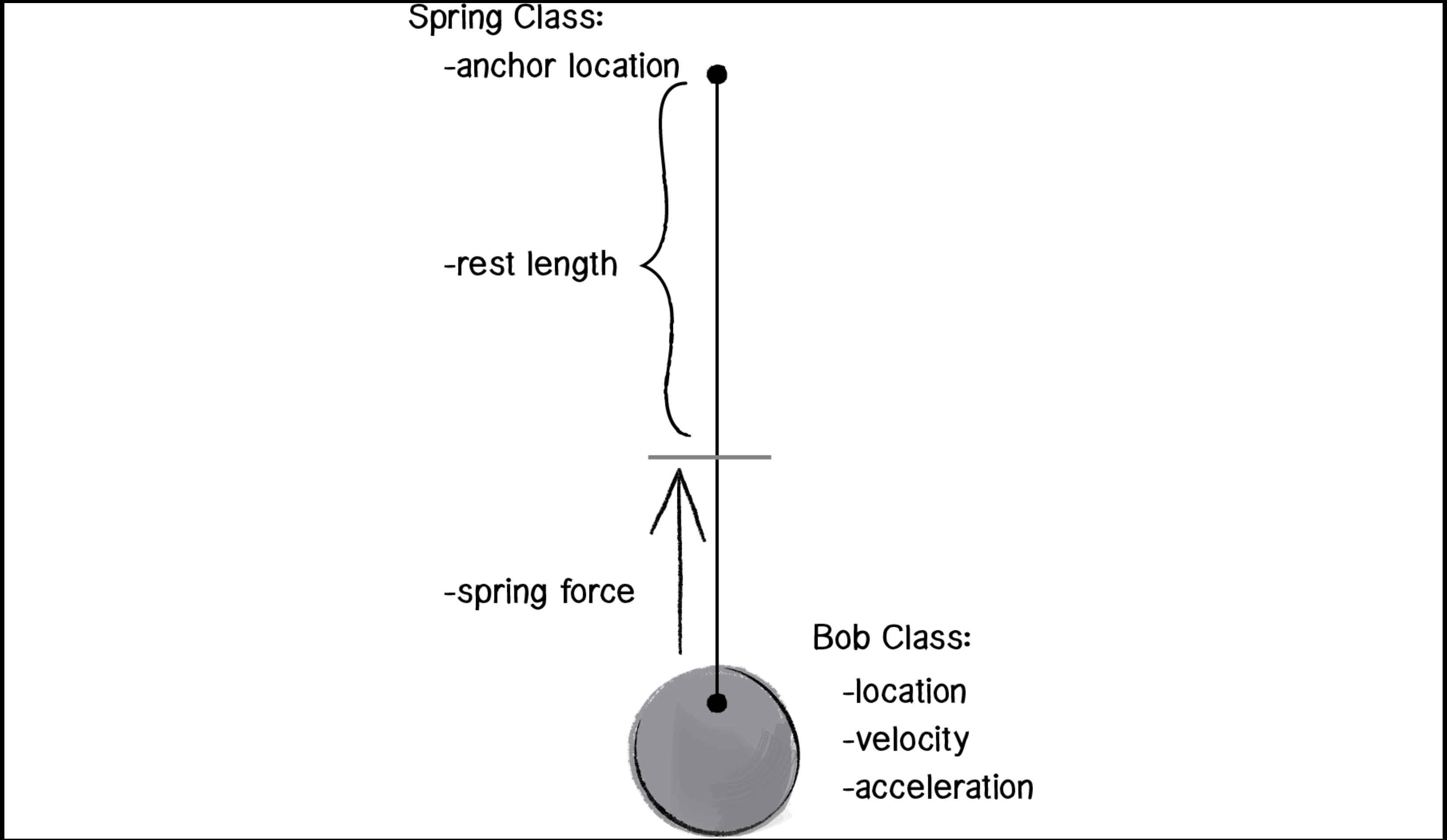
Spring Forces



Spring Forces

```
float k = 0.1;
PVector force = PVector.sub(bob,anchor);
float currentLength= dir.mag();
float x = restLength-currentLength;
//Direction of spring force (unit vector)
force.normalize();
//Putting it together: direction and magnitude!
force.mult(-1 * k * x);
```

Spring Class



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