

Mush & Squush: Soft-Body Physics

by Justin Shacklette

bit.ly/mush_and_squush

Demo #1

Squishy Balls

Who Am I?

Some guy...

...knows some physics (PhD)

...knows some iOS

→ Conversation Please

What is Soft-Body Physics?

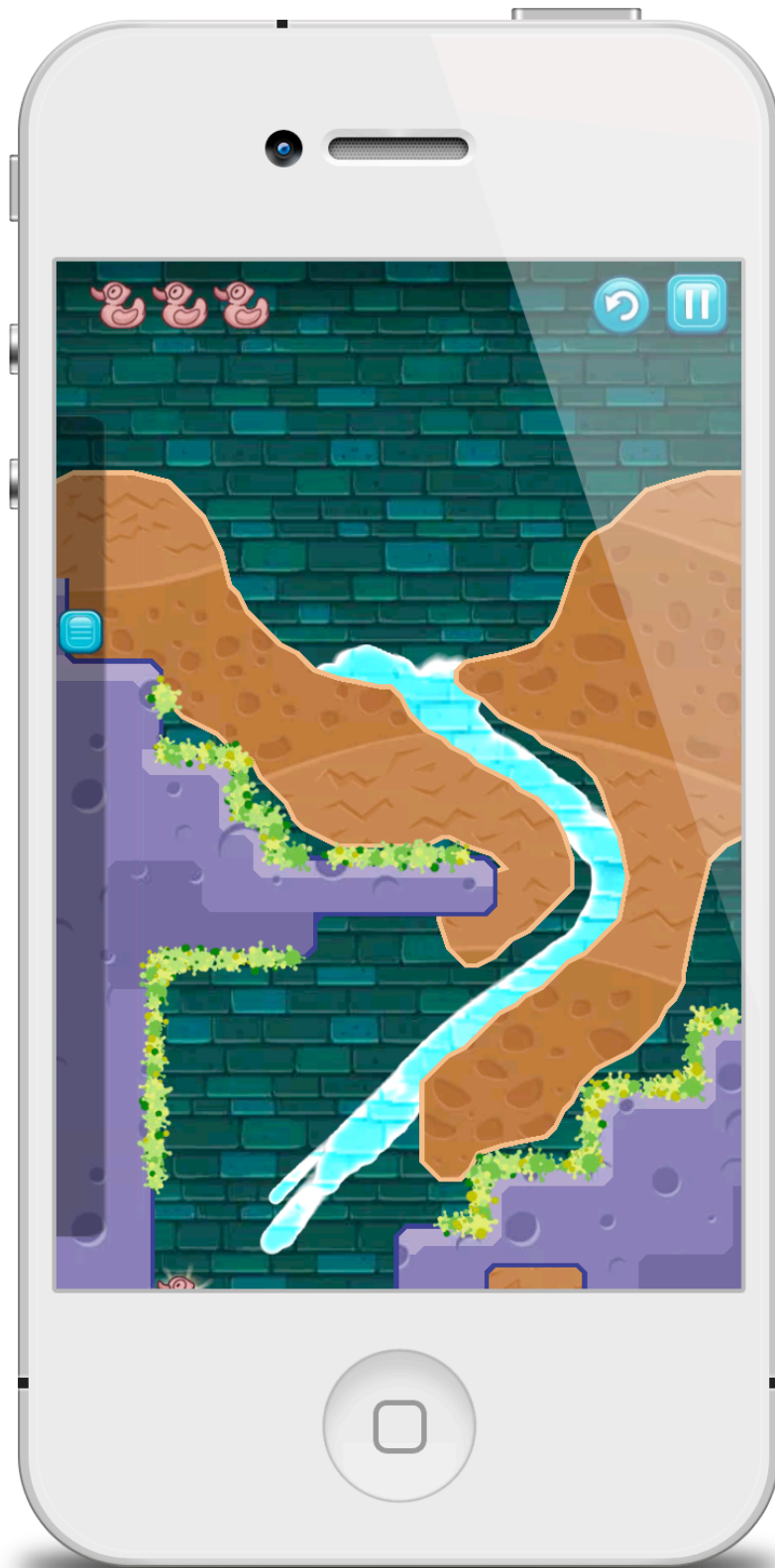
- Anything non-rigid
- Deforming objects
- Deforming the environment
- Fluids
- Rigid Bones, but Jointed

Why Physics?

- Physics is real
- Touch is physical
- (some) Real objects deform
- Physics is hard-wired in our brains

→ Immersive

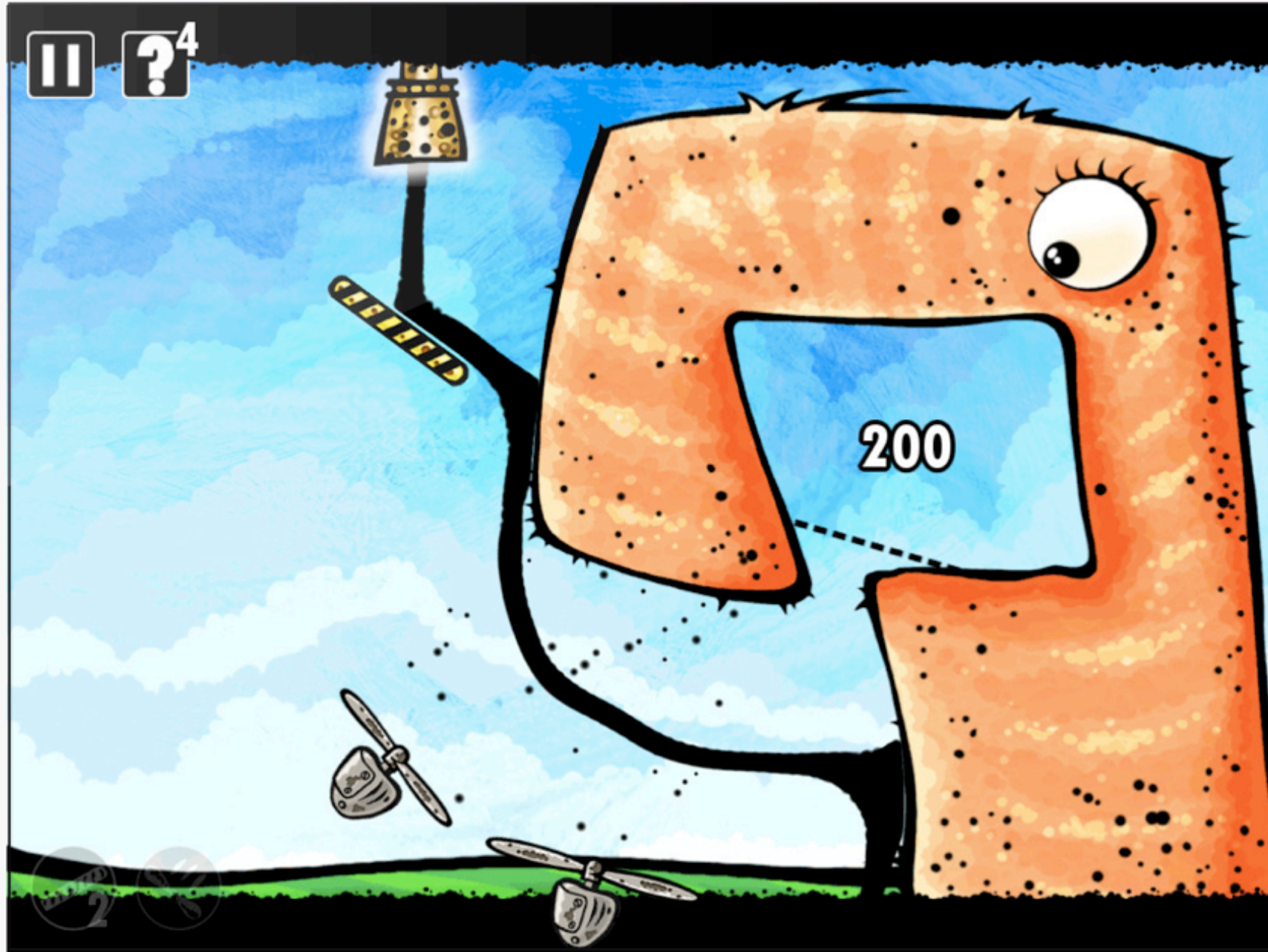
Where's My Water



Jelly Car 3



Feed Me Oil HD



Real Enough?

- Exact is expensive
- Approximations are required
- Lose energy → like friction
- Just experiment...you'll know

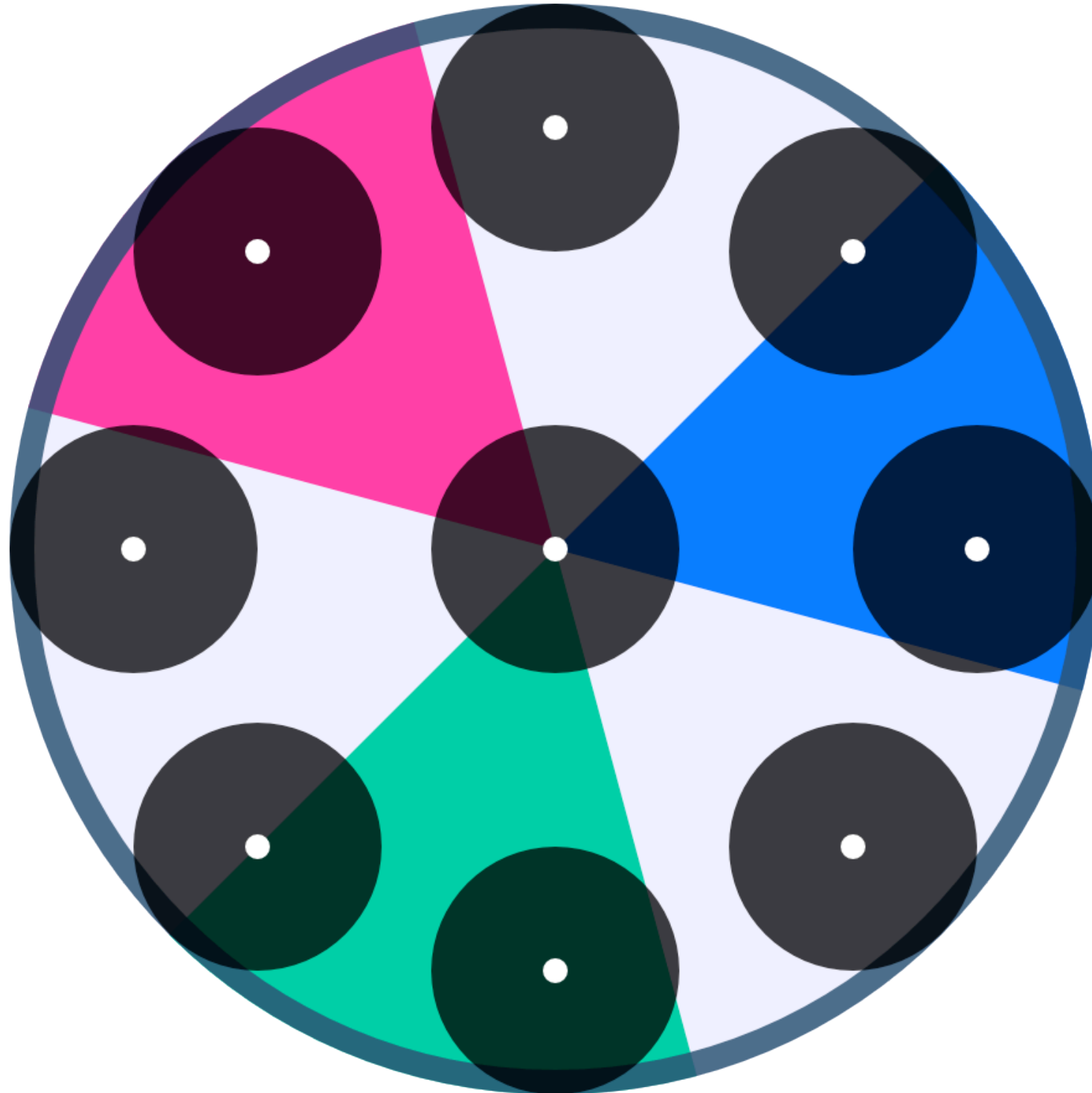
Deforming a Sprite

1. Sprite
2. Sub-Bodies
3. Springs
4. Triangle Mesh
5. Texture

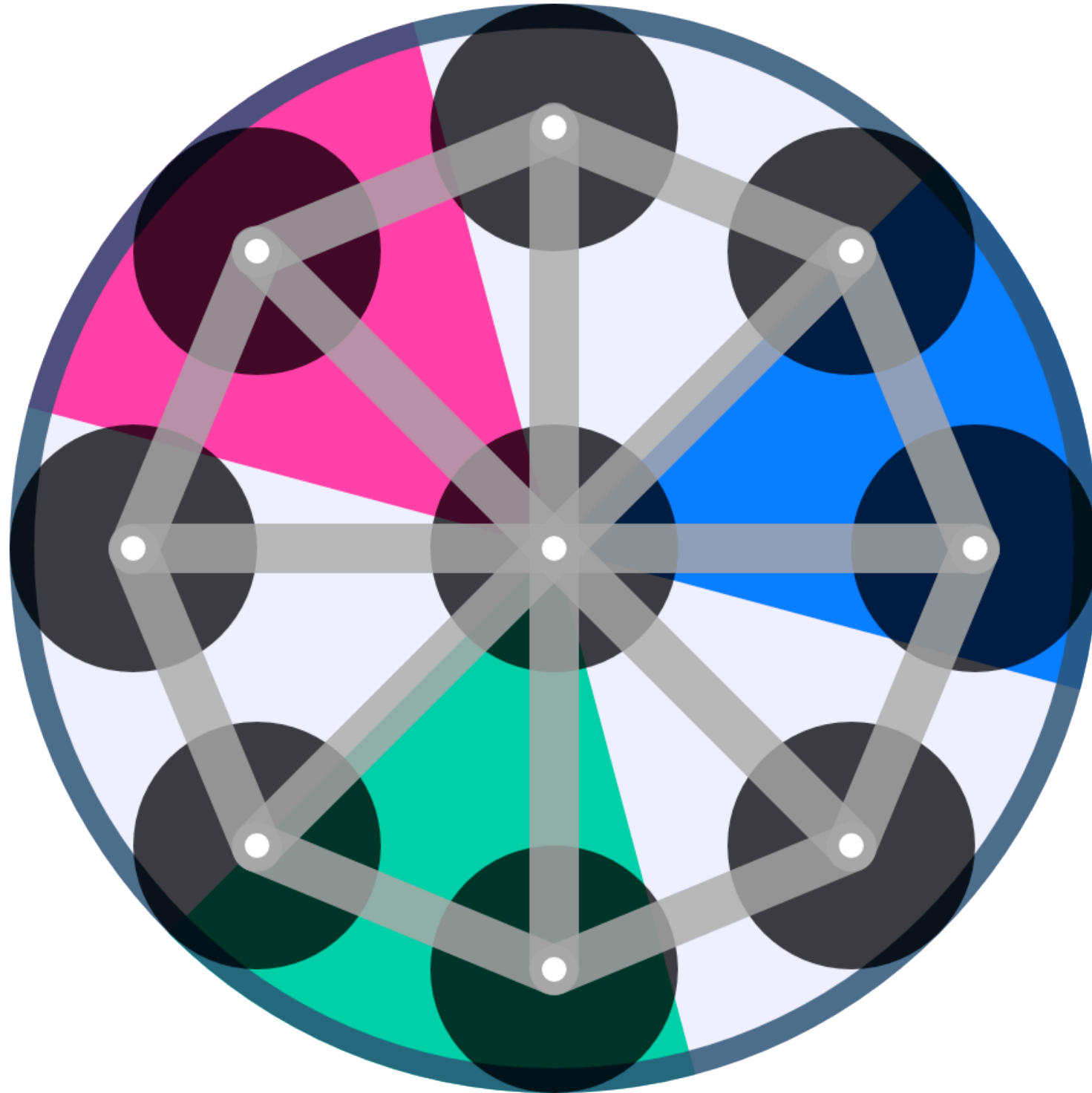
1. Sprite



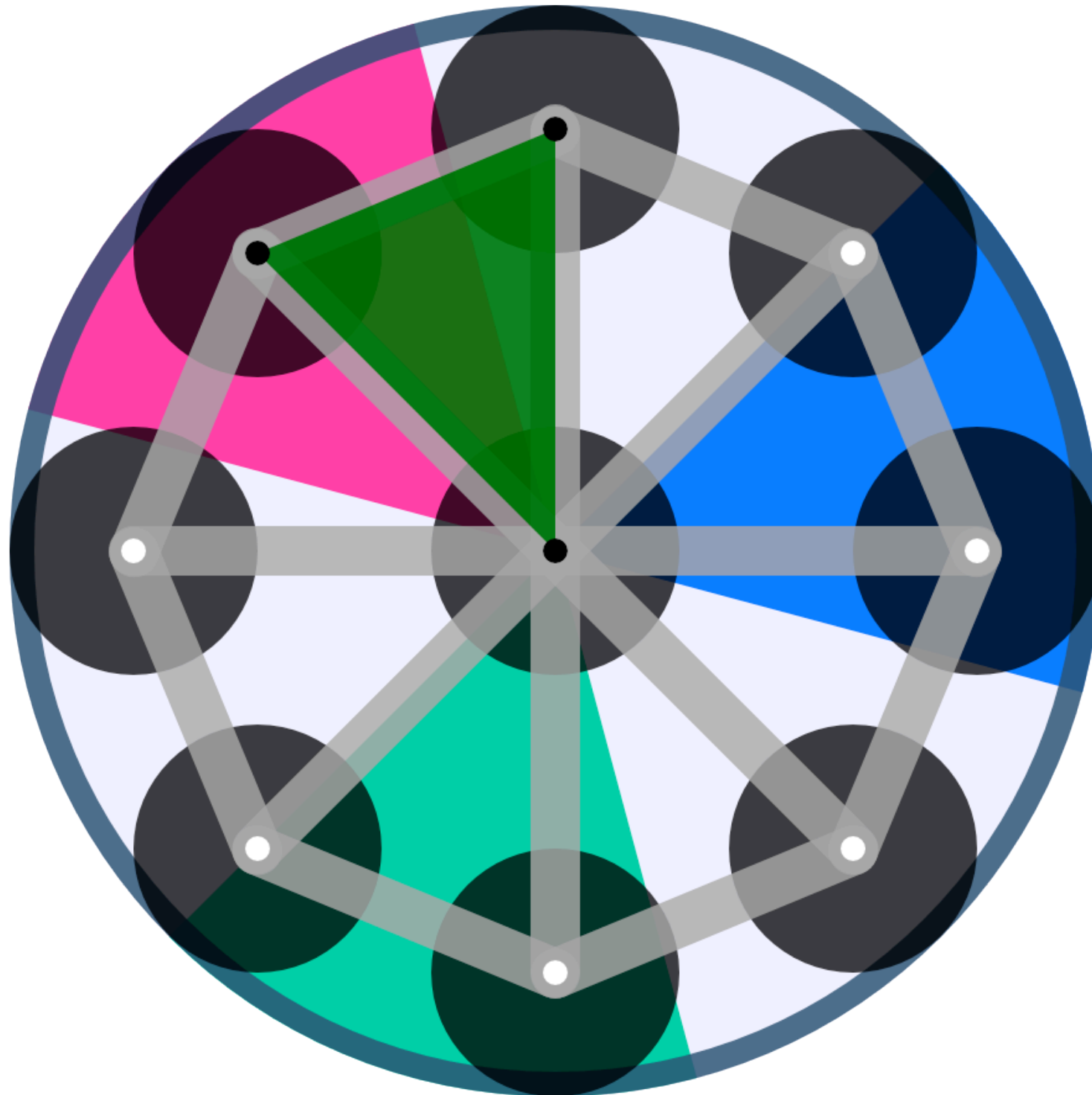
2. Sub-Bodies



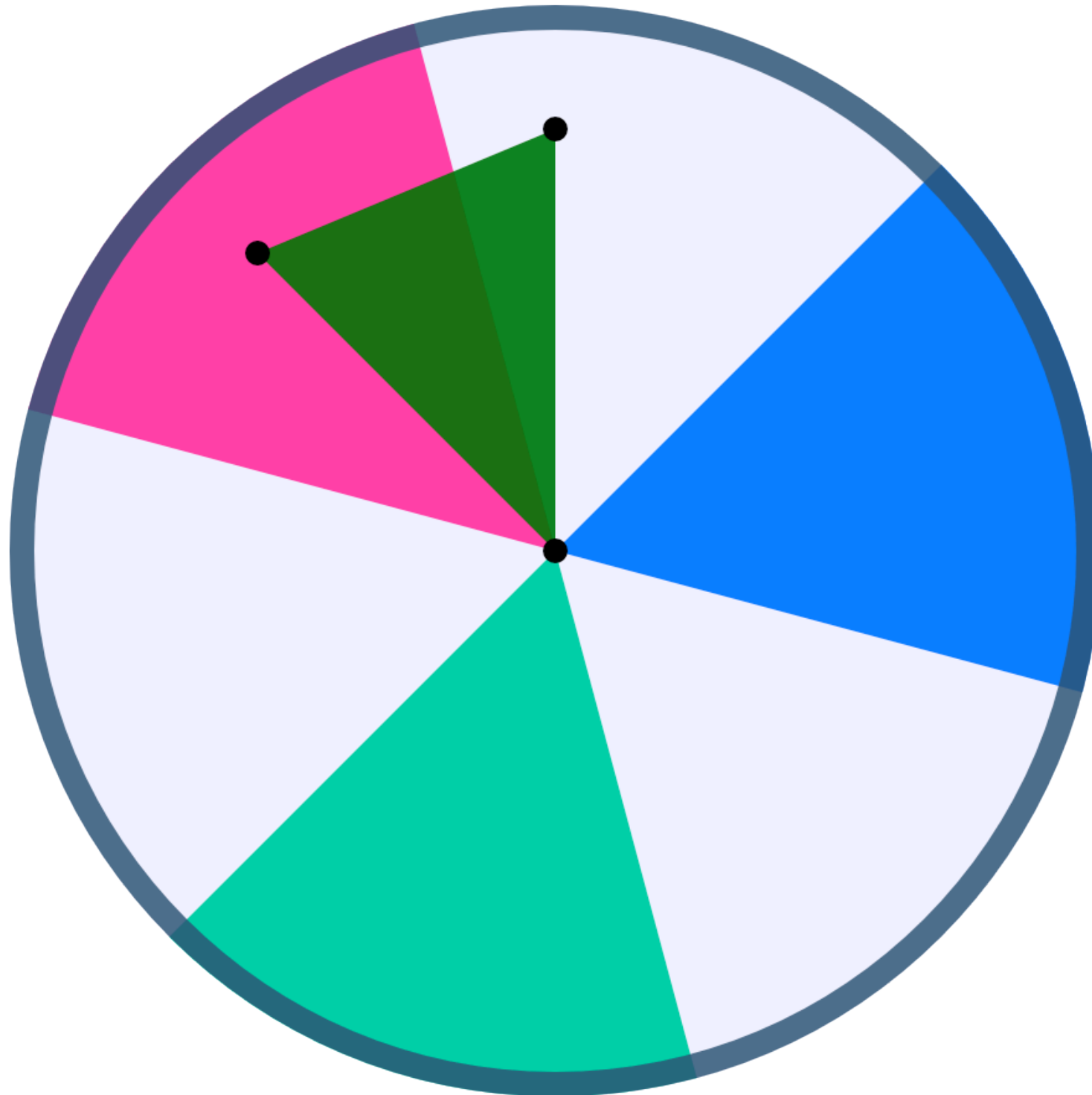
3. Springs



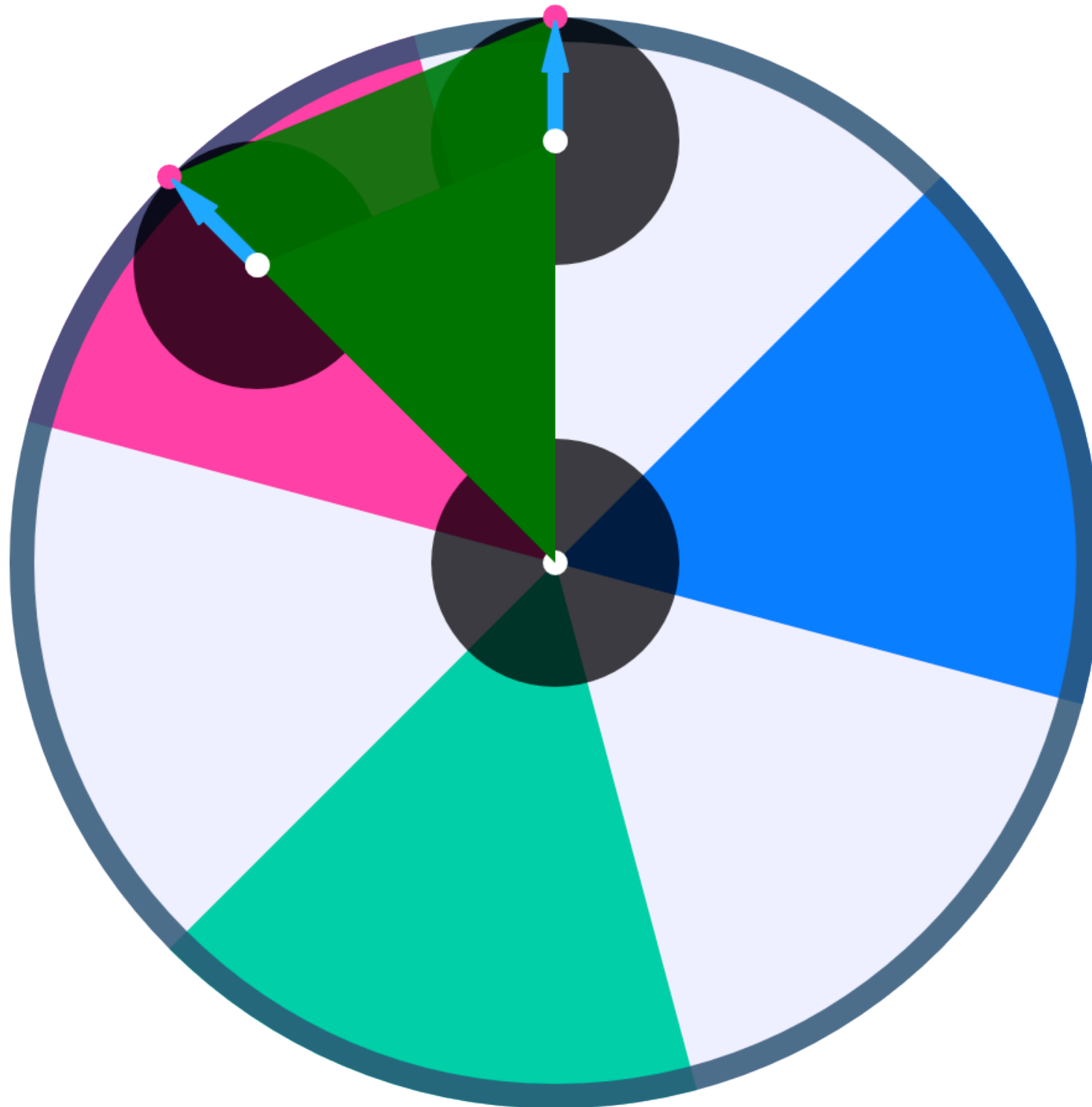
4. Triangle Mesh



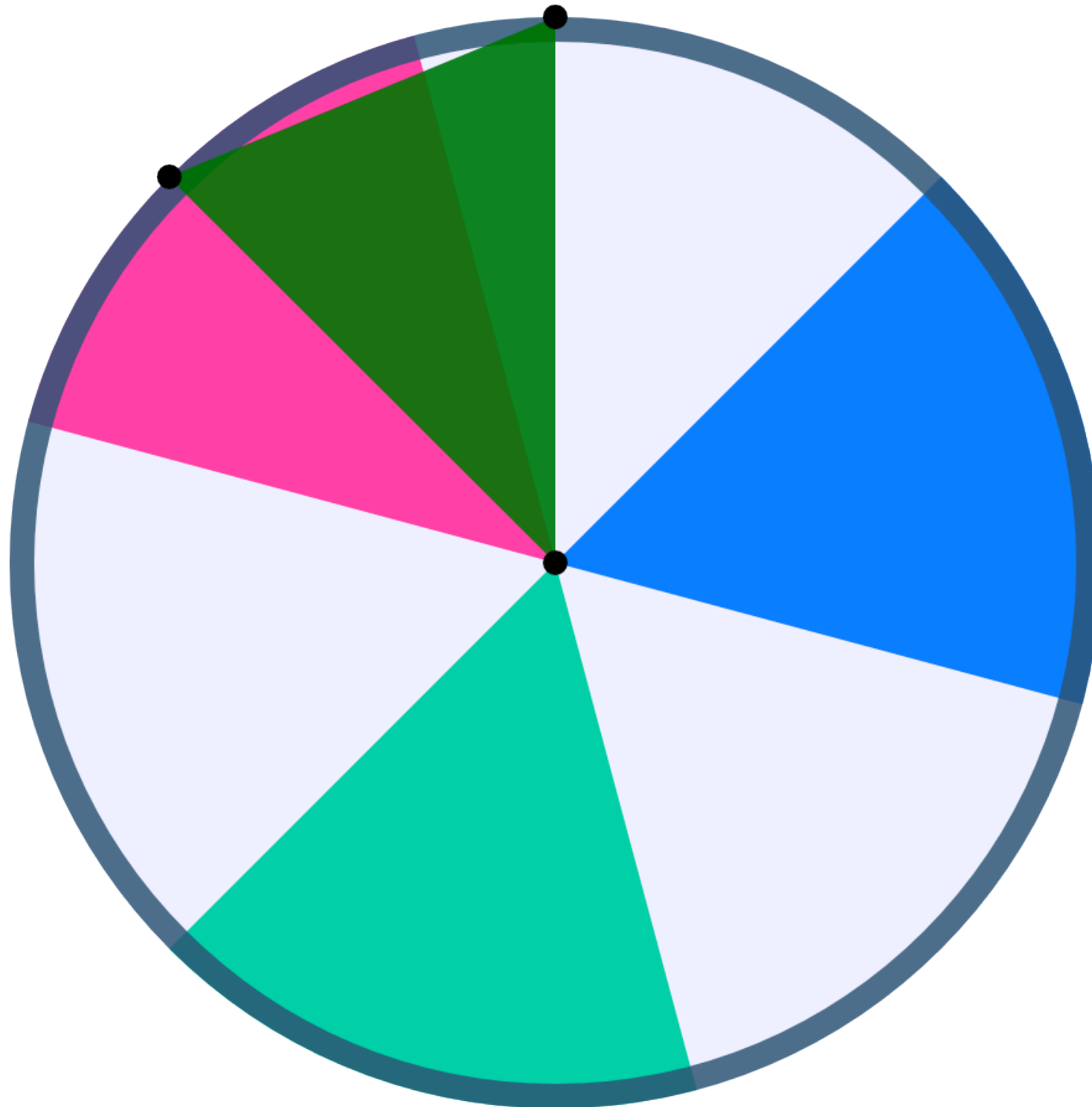
4. Triangle Mesh



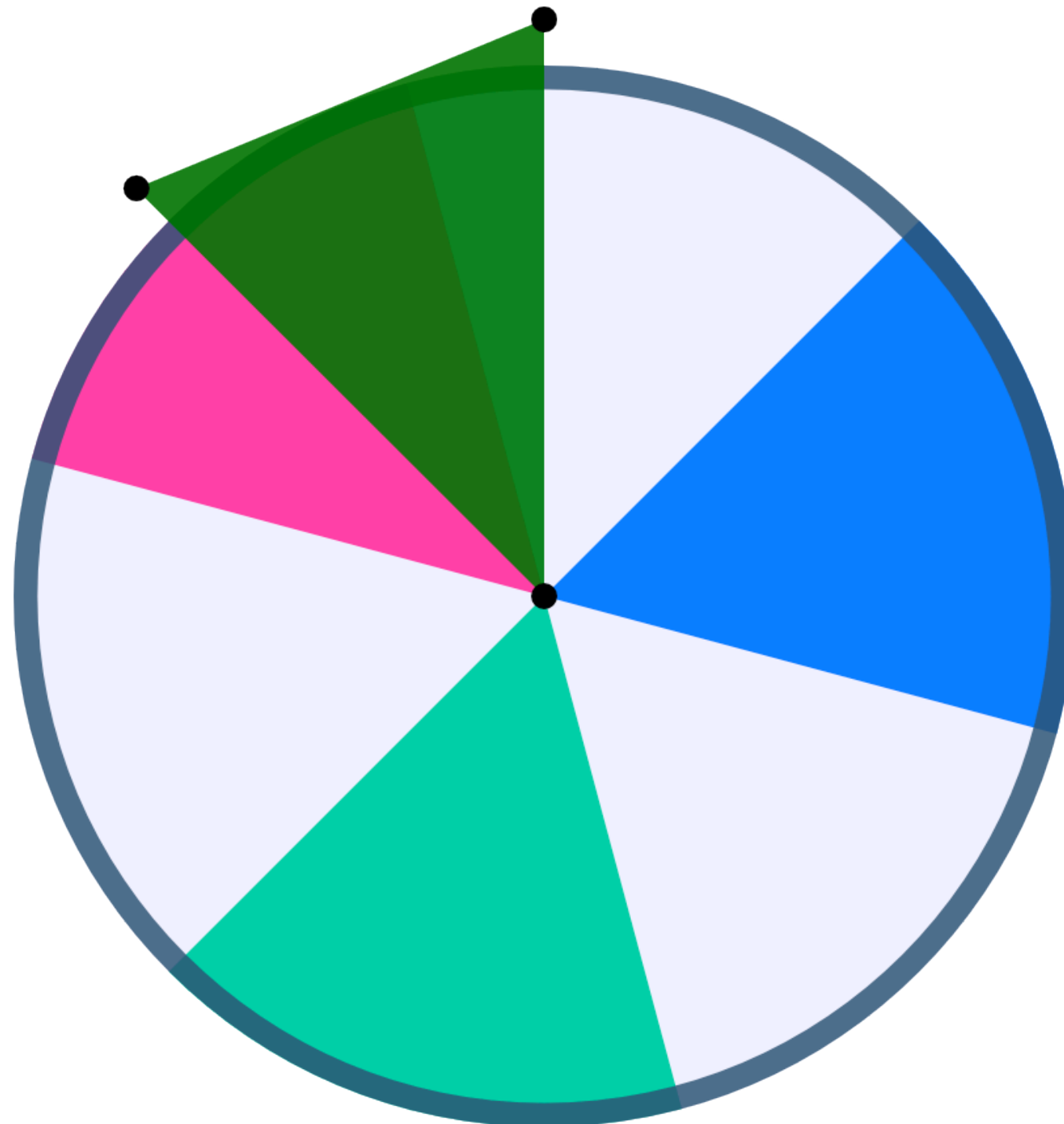
4. Triangle Mesh



4. Triangle Mesh



4. Triangle Mesh

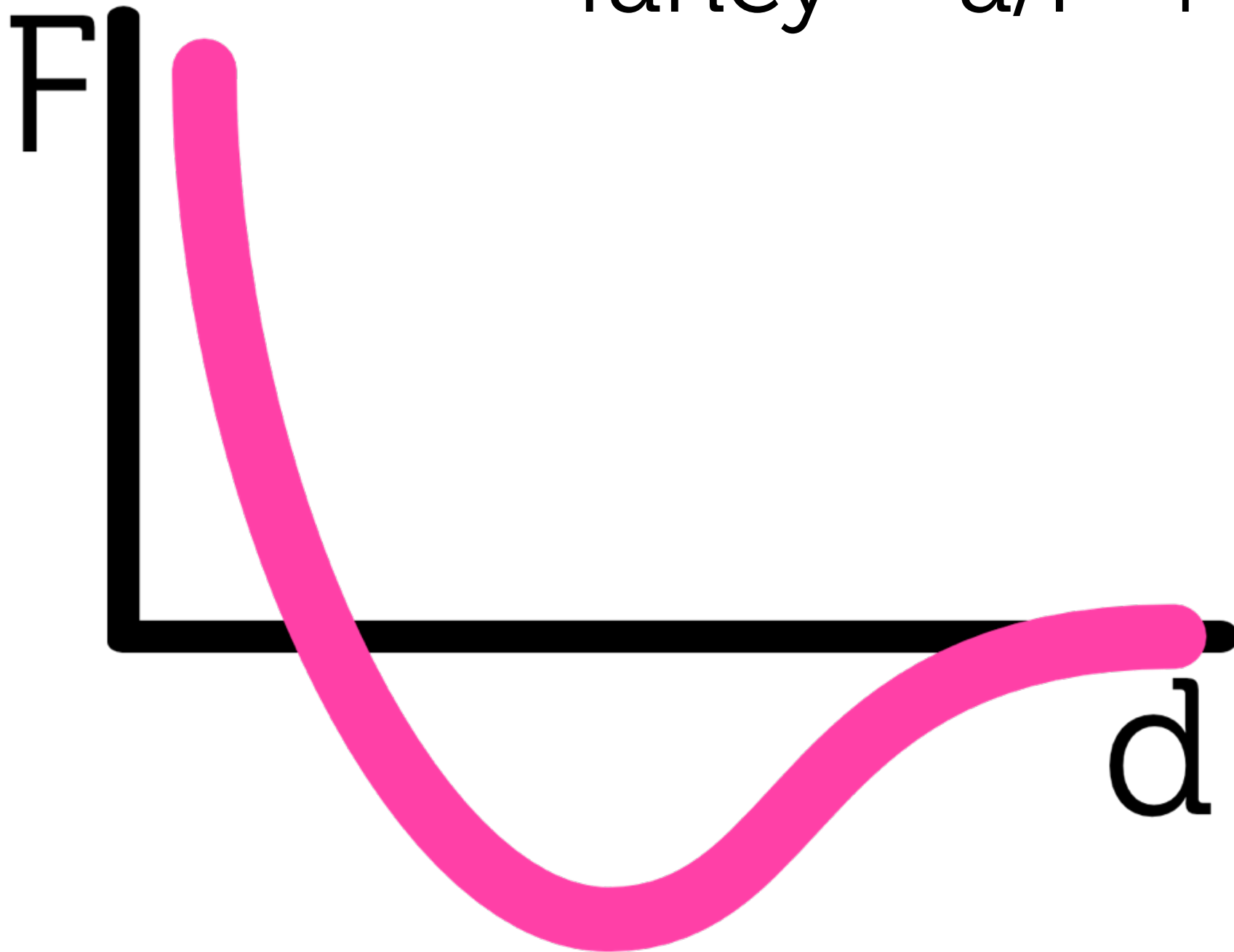


Demo #2

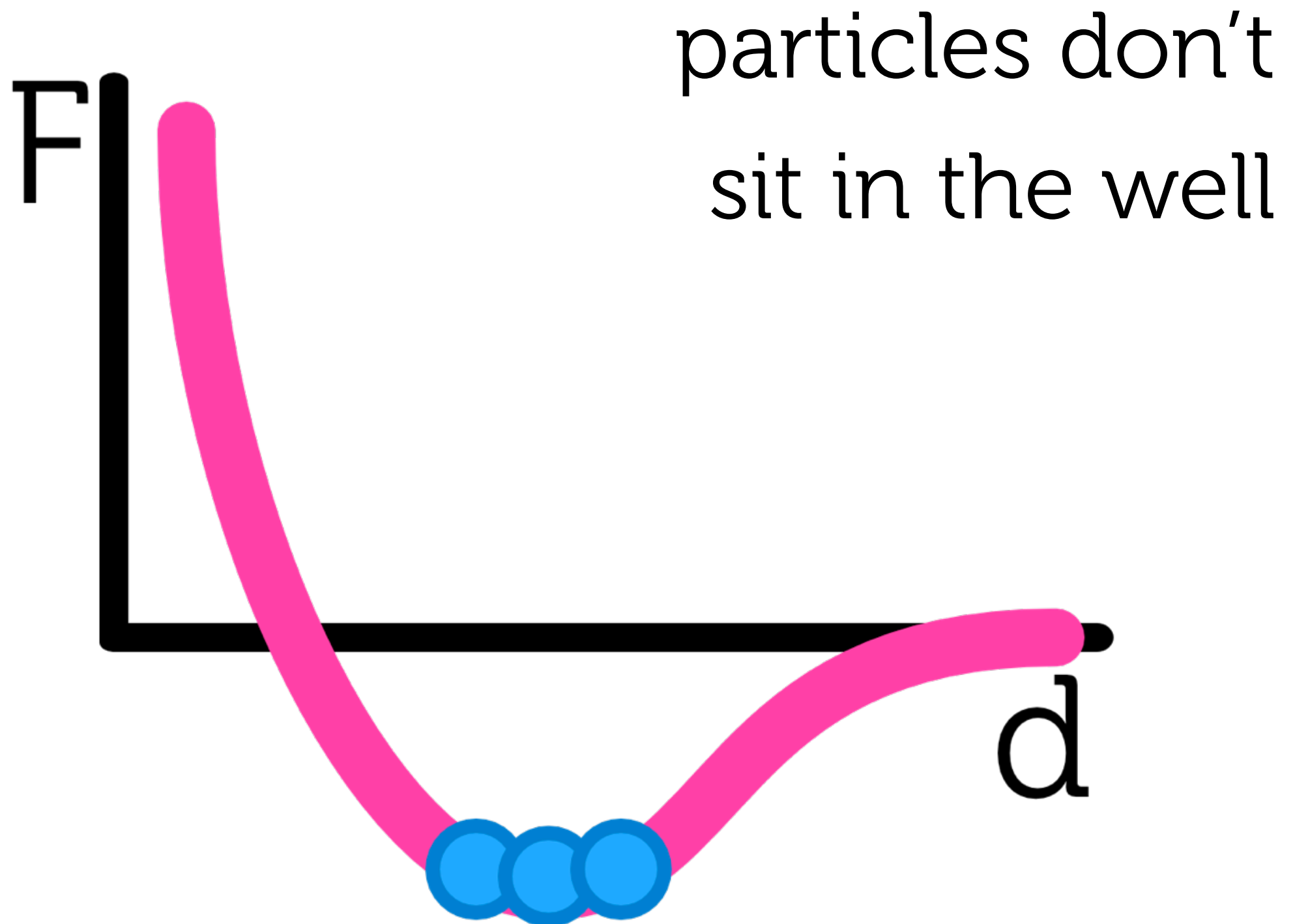
Watery Balls

Attract + Repel

$$\text{fancy} \sim a/r^2 + b/r^4$$

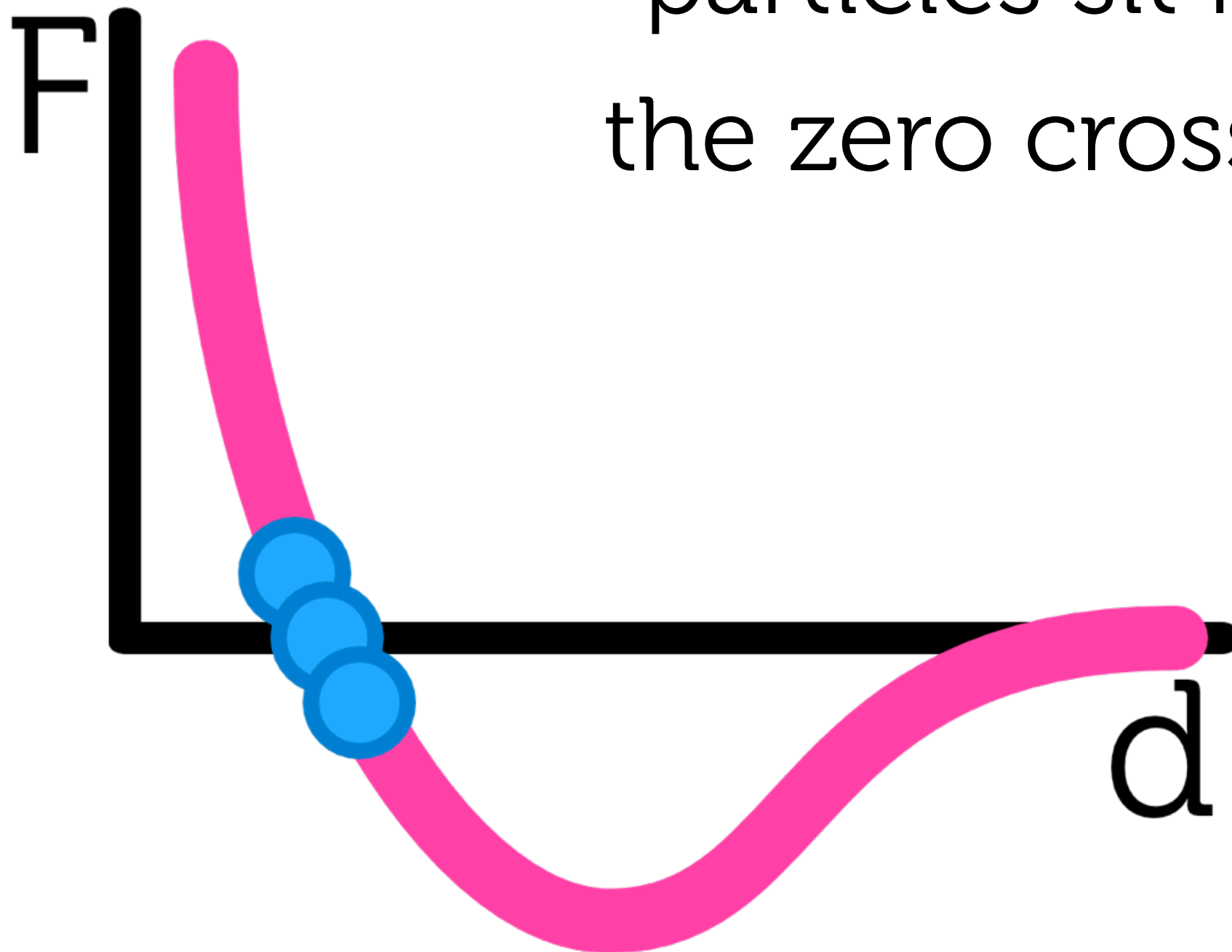


Attract + Repel



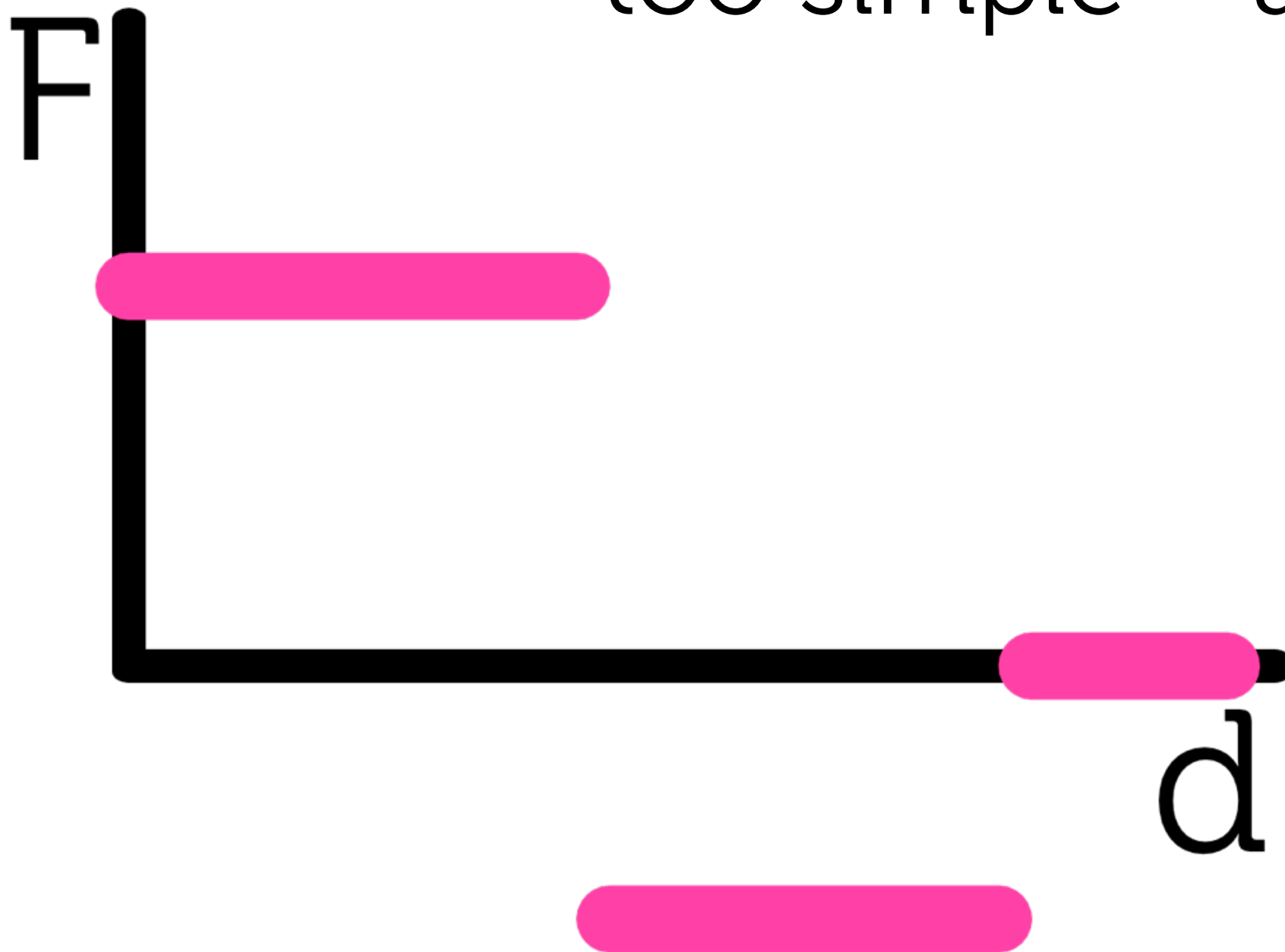
Attract + Repel

particles sit near
the zero crossing



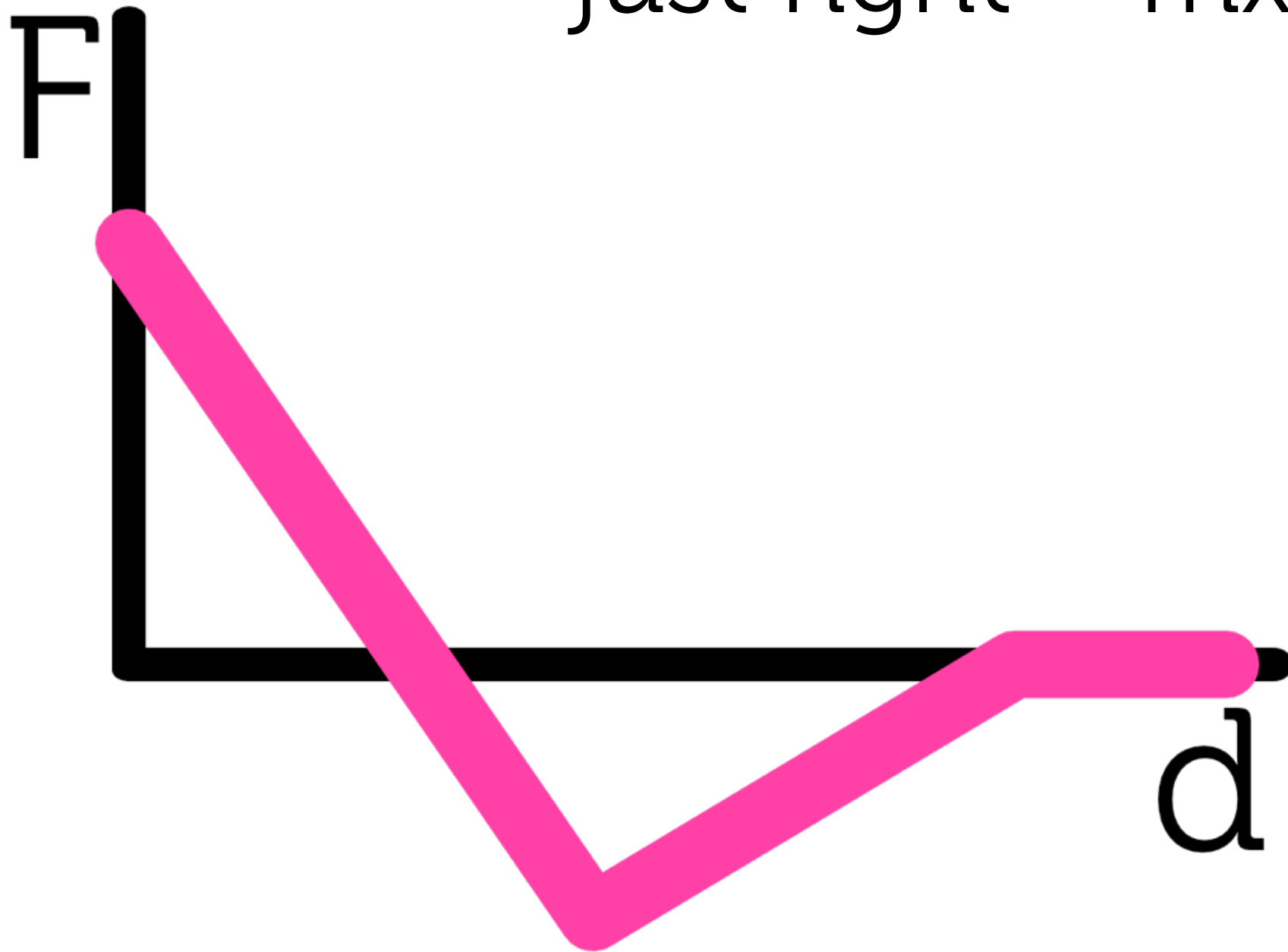
Attract + Repel

too simple $\sim a, b, 0$



Attract + Repel

just right $\sim mx + b$



Compute Force

```
for (int i=0; i<N; i++) {  
    Ball *b = _balls[i];  
    for (int j=i+1; j<N; j++) {  
        Ball *b2 = _balls[j];  
        //compute A from F...  
        b.acc += A;  
        b2.acc += -A;  
    }  
}
```

Velocity Verlet Integration

$$x_{n+1} = x_n + v_n \Delta t + a_n \Delta t^2$$

$$v_{n+1} = v_n + \frac{1}{2}(a_n + a_{n+1}) \Delta t$$

```
for (Ball *b in _balls) {  
    b.position = ccpAdd(  
        ccpAdd(b.position, ccpMult(b.vel, dt)),  
        ccpMult(b.acc, dt*dt));  
    b.vel = ccpAdd(b.vel, ccpMult(b.acc, dt));  
}
```

Soft-Body Challenges

- must be fun
- unexpected
- expensive computations
- expensive in effort

Wise You Must Be

- don't deform everything, pick:
 - main character
 - environment
 - some other entity
- special effects
- animations
- fluids

Questions?

bit.ly/mush_and_squush

justin@saturnboy.com

@saturnboy

Links

Tracing Those Angry Birds to the Dawn of Man

<http://online.wsj.com/article/SB10001424052748703779704576074222543274268.html>

The cocos2d source

<https://github.com/cocos2d/cocos2d-iphone>

PRKit - custom polygon triangulator

<https://github.com/asinesio/cocos2d-PRKit>