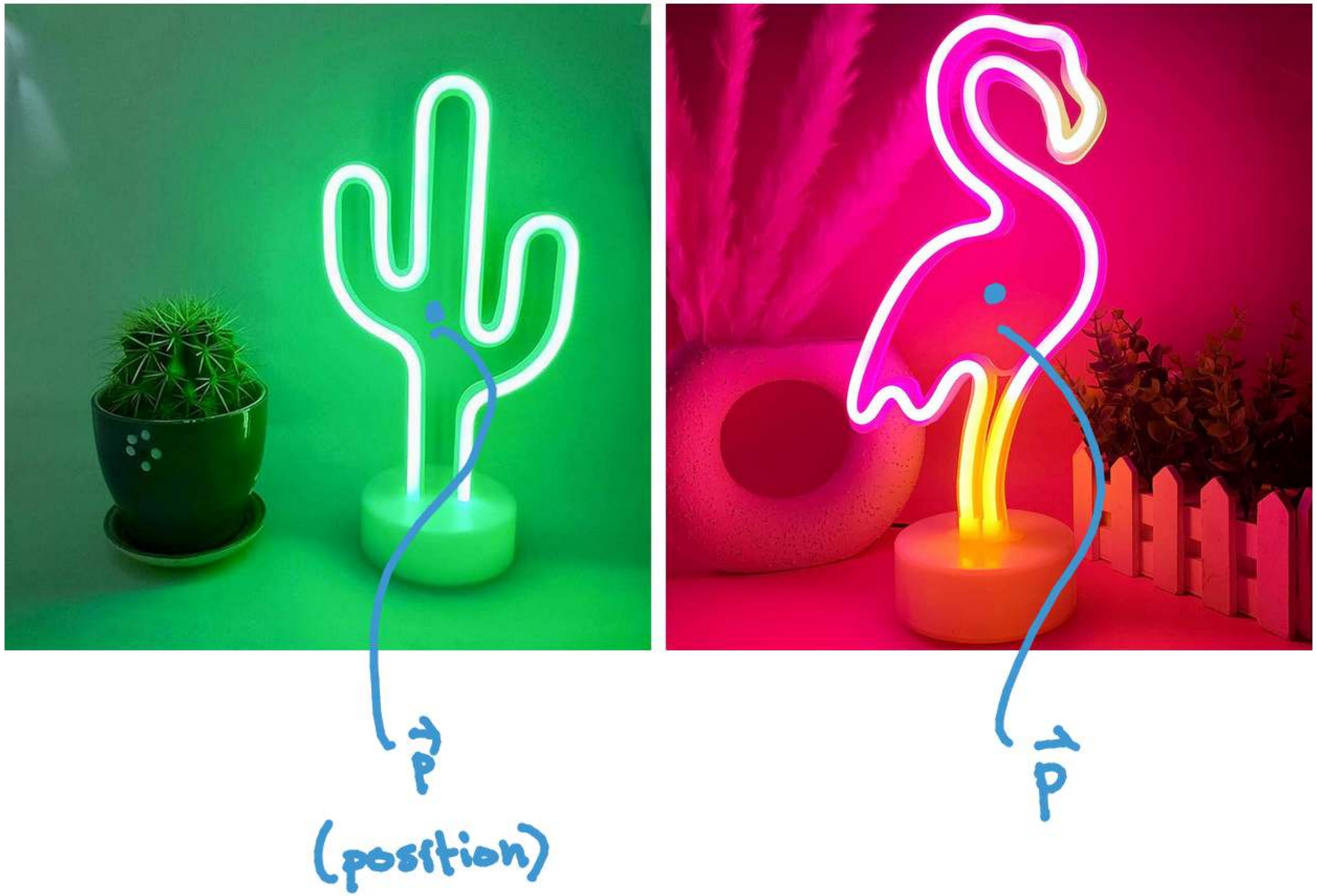
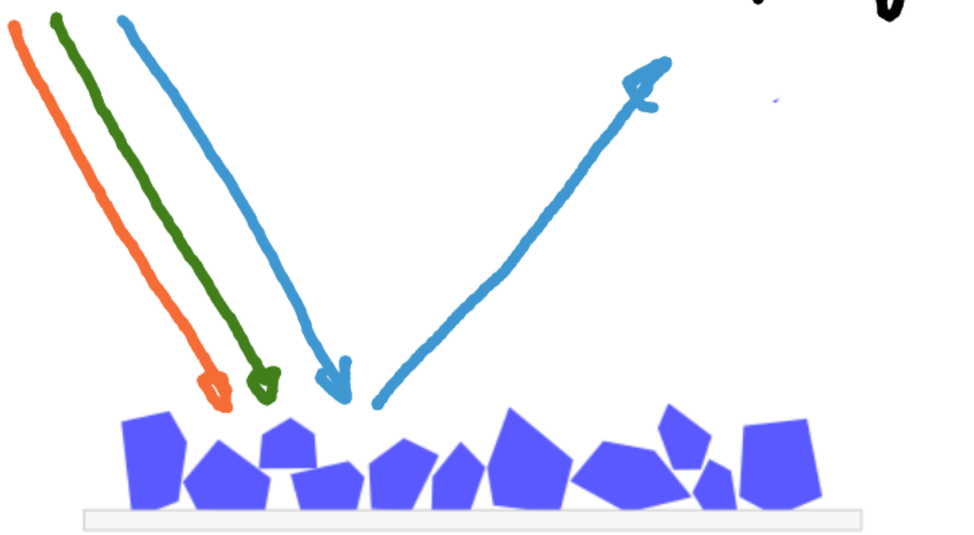
Ingredient #1: Light sources have a color, and a location or direction.



Ingredient #2: Materials reflect certain light components, absorb others.



Things we need to consider:

- **how much** of the incoming light is reflected?
- what **direction** is light reflected?

The ambient contribution provides background lighting.

Ca term
(ambient color)
(r,g,b components)

[0,255]

[0,1]

What is going on? What does `color.glsl` do?

1.) geometry broken up into "fragments"

2) our job (in color.glsl) is to assign color

how??

take cs 461

Light scatters in all directions across matte-like surfaces.

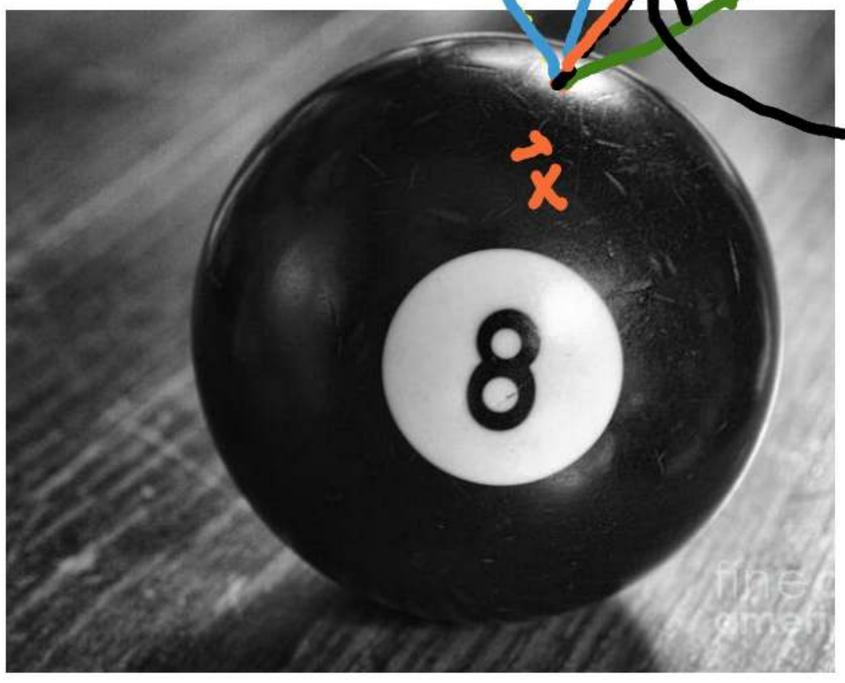
Lambert's law

color is proportional to $\cos\theta$

$$\vec{n} \cdot \vec{l} = \|\vec{n}\| \, \|\vec{l}\| \cos\theta$$

add $+ c_d \max(\vec{n} \cdot \vec{l}, 0)$

Specular term adds a highlight to glossy surfaces.



$\vec{p}$ $\vec{e}$ (eye)

$\vec{l} = \frac{\vec{p} - \vec{x}}{\|\vec{p} - \vec{x}\|}$ $\vec{v} = \frac{\vec{e} - \vec{x}}{\|\vec{e} - \vec{x}\|}$ } vec3

$\vec{r} = -\vec{l} + 2 * (\vec{n} \cdot \vec{l}) * \vec{n}$

σ proportional to $\cos\sigma$

$+ C_s \max(0., \text{dot}(v,r))^{p}$

use pow(a,b) for a^b

shininess exponent (use 32.0)

Final color:

$$c = c_a + c_d \max\left(0, \vec{n} \cdot \vec{l}\right) + c_s \max(0, \vec{v} \cdot \vec{r})^p$$

- $\vec{n}$: unit vector perpendicular to surface,
- $\vec{l}$: unit vector from surface point to light,
- $\vec{r} = -\vec{l} + 2(\vec{l} \cdot \vec{n})\vec{n}$ (reflection of $\vec{l}$ across $\vec{n}$),
- $\vec{v}$: unit vector from surface point to eye,
- p: shininess

Banding the diffuse term to make it look cartoony

$$\cos\theta = \vec{n} \cdot \vec{l}$$

	value used
0 - 0.25	0
0.25 - 0.5	0.25
0.5 - 0.75	0.5
0.75 - 1.0	0.75