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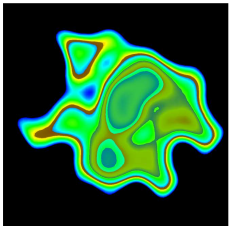
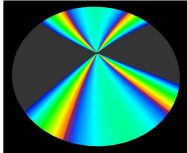
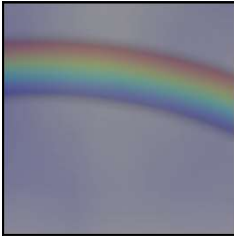
## Spectral Effects: Chromatic Refraction and Wavelength Interference



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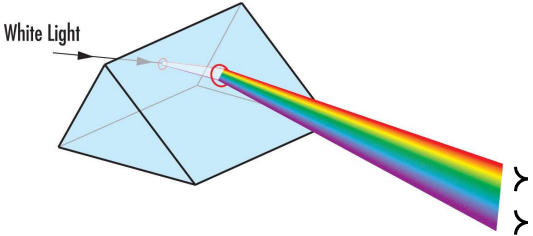
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### Each Wavelength of Light Has a Slightly Different Index of Refraction so that each Wavelength Bends Differently in a Prism



White Light

<http://www.edmundoptics.com>

Different colors are seen in different places

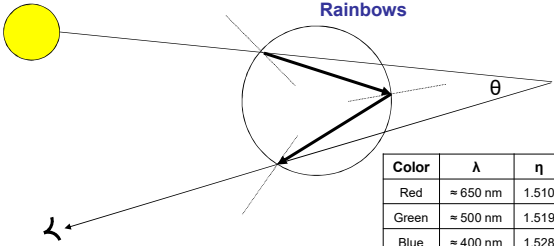


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### Rainbows



Primary Rainbow      Secondary Rainbow

Color	$\lambda$	$\eta$	$\Theta$	$\cos\Theta$	$\Theta\Theta$
Red	$\approx 650 \text{ nm}$	1.510	$42^\circ$	0.743	$50.0^\circ$
Green	$\approx 500 \text{ nm}$	1.519	$41^\circ$	0.755	$51.5^\circ$
Blue	$\approx 400 \text{ nm}$	1.528	$40^\circ$	0.766	$53.0^\circ$

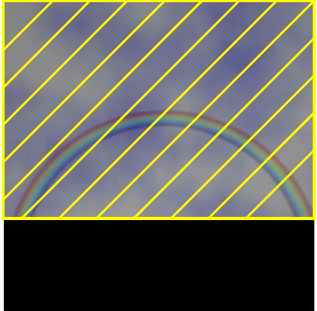
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### Rainbow Strategy

Or anything else, really. You just need a large "fragment-generator".

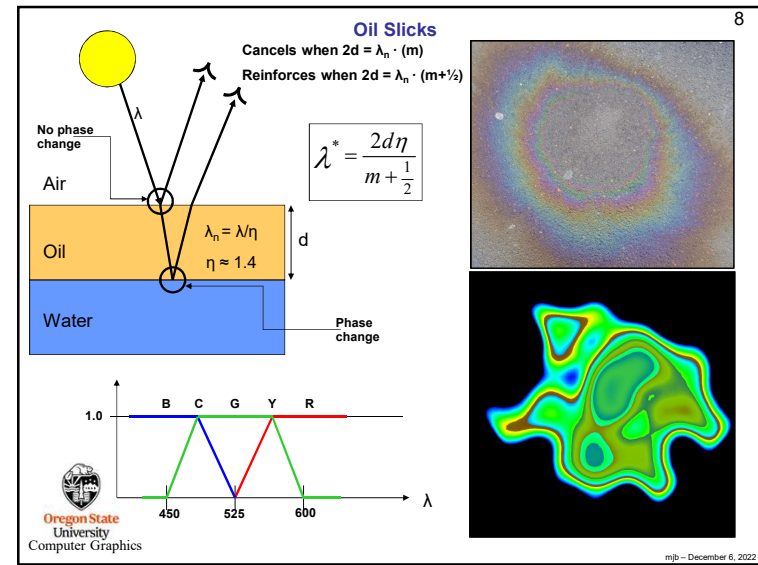
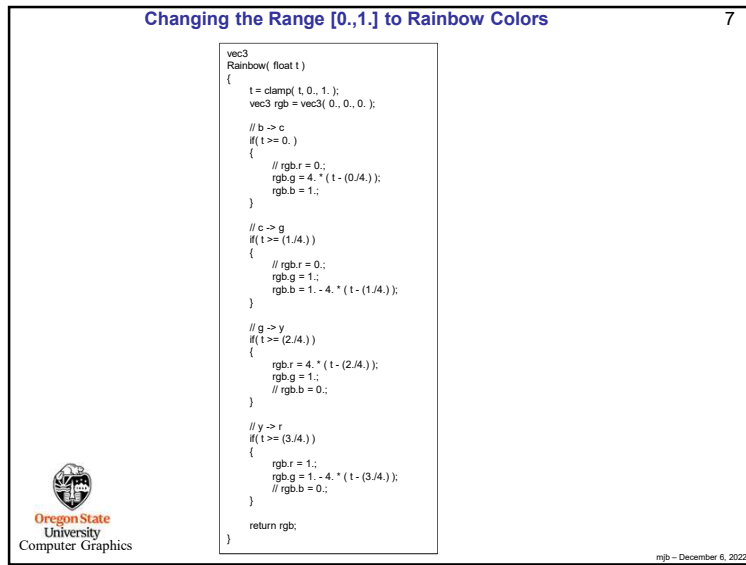
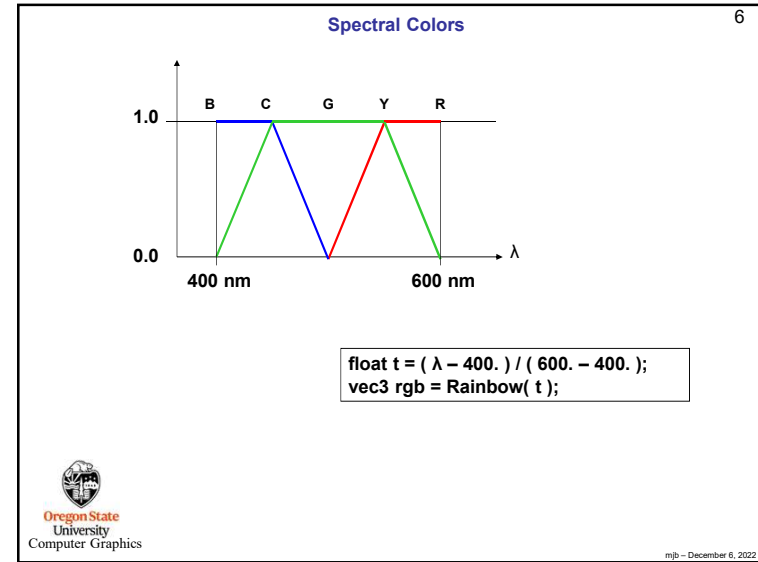
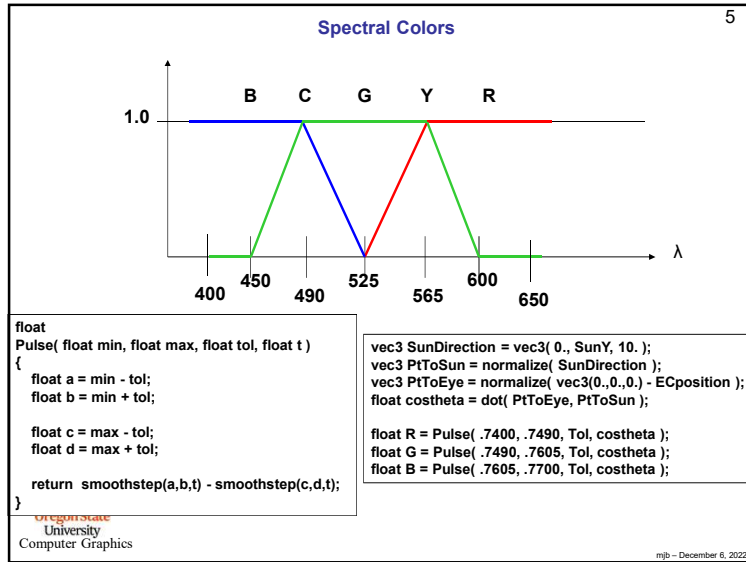
1. Draw one big quadrilateral across the scene
2. Anywhere that  $.7400 \leq \cos(\Theta) \leq .7700$ , paint a color
3. Otherwise, discard.





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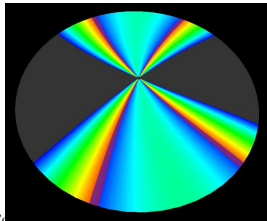
**Diffraction Gratings** 9

For a CD,  $d = 1600 \text{ nm}$   
For a DVD,  $d = 740 \text{ nm}$

On the way in, Ray A travels  $d \cos(\phi_i)$  less than Ray B does. On the way out, Ray A travels  $d \cos(\phi_r)$  more than Ray B does.

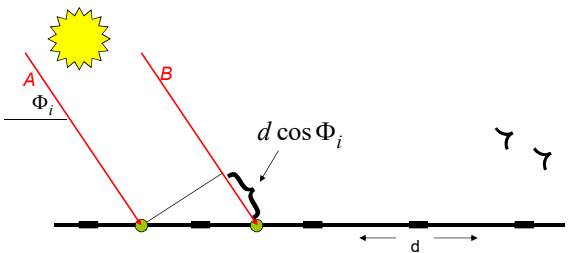
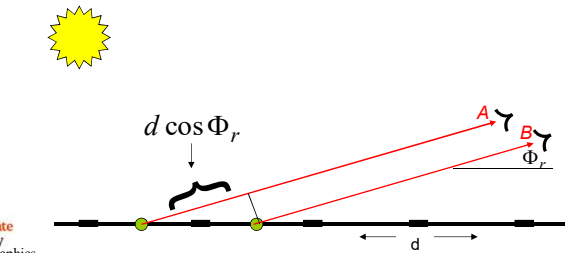
So, wavelengths reinforce when  $\text{abs}[d \cos(\phi_i) - d \cos(\phi_r)]$  is a multiple of the wavelength =  $m\lambda$


$$\lambda^* = d \cdot | \cos(\phi_i) - \cos(\phi_r) | / m$$



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**Diffraction Gratings** 11

Call the unit vector from the point to the light **ToLight**.

Call the unit vector from the point to the eye **ToEye**.

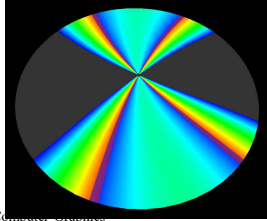
Call the transformed tangential unit vector **Tangent**.

Then,  $\cos(\phi_i)$  is  $\text{ToLight} \cdot \text{Tangent}$

And,  $\cos(\phi_r)$  is  $\text{ToEye} \cdot (-\text{Tangent})$

So that  $\cos(\phi_i) - \cos(\phi_r)$  is:  $\text{Tangent} \cdot (\text{ToLight} + \text{ToEye})$

$$\lambda^* = d \cdot | \cos(\phi_i) - \cos(\phi_r) | / m$$



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