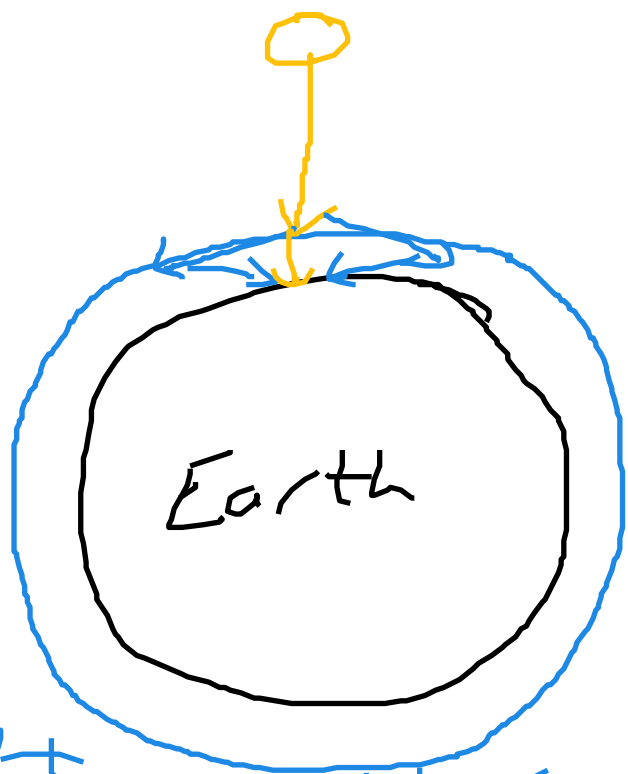




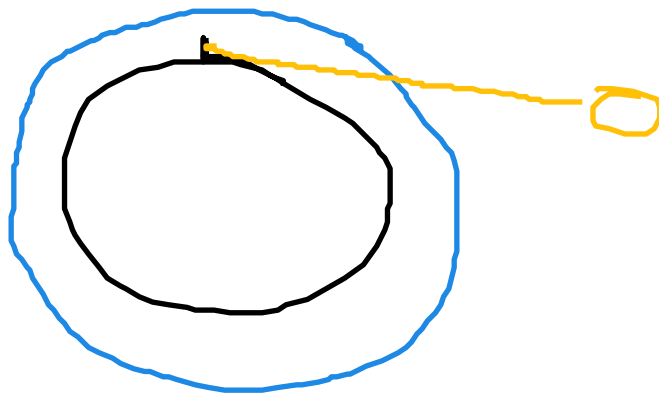
Why is the sky blue?

Rayleigh scattering

Blue light, having a smaller wavelength, is more easily scattered by air molecules, dust, etc than red light.

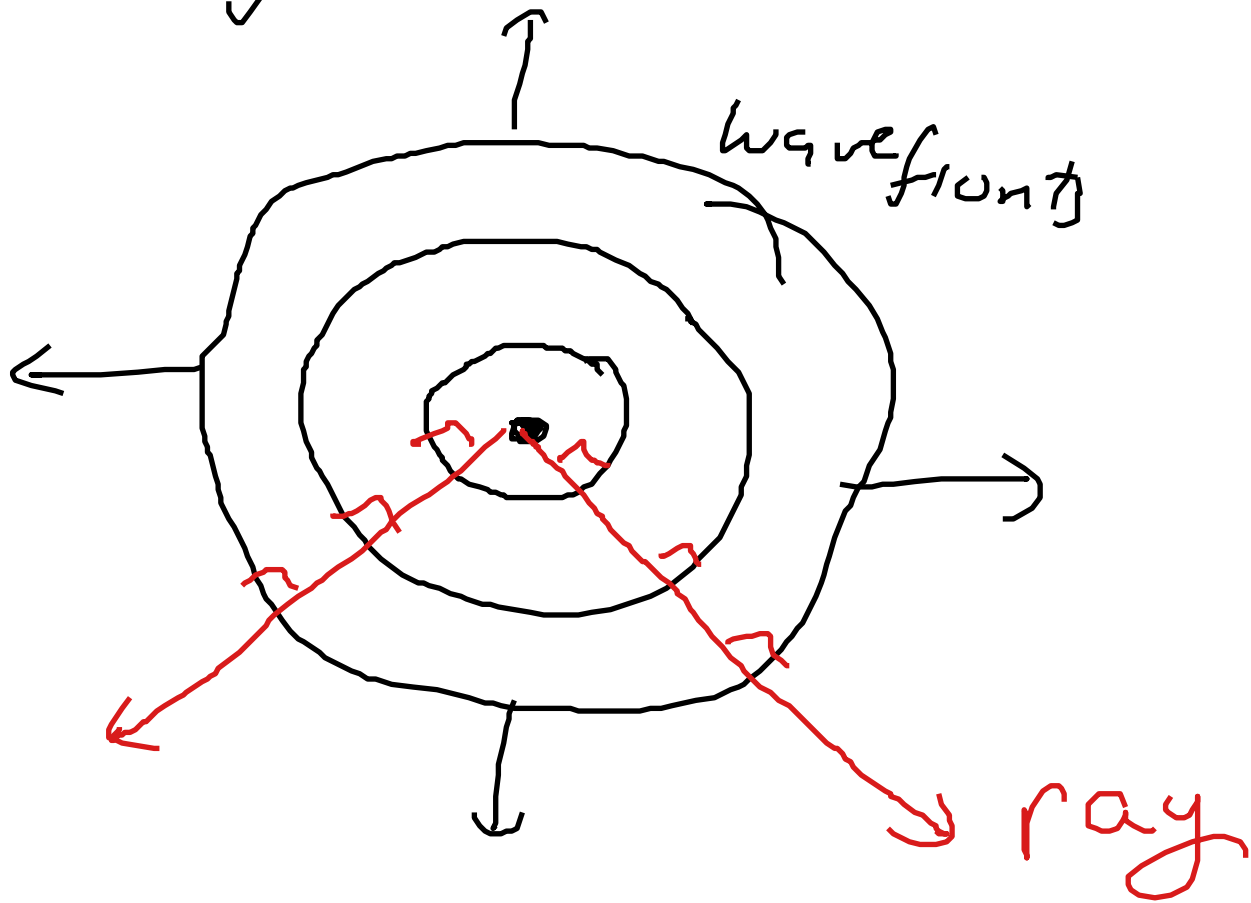


Blue light scatters, & is reflected from other parts of the sky back to you.



At sundown, sunlight passes  
through a lot more atmosphere  
loses more blue light →  
Sun looks reddish

# Ray Optics



- points in direction the wave is moving
- perpendicular to wavefronts

↳ light is a thing that moves in a direction

5  
Speed of Light

$$c = 3 \times 10^8 \text{ m/s}$$

In vacuum

(fastest possible speed for  
energy/mass/information  
to travel)

In materials,  
light slows down

e.g. water  $v = 2.3 \times 10^8 \text{ m/s}$

# Index of Refraction

$$\frac{3 \times 10^8 \text{ m/s}}{2.3 \times 10^8 \text{ m/s}} = 1.3 \text{ for water}$$

$$n = \frac{c}{v} \rightarrow v = \frac{c}{n}$$

$$n \geq 1$$

$n = 1$  for  
vacuum

because  $v \leq c$

7  
 $n$ : "resistance" of material  
to light moving through it

air:  $n = 1.0003 \approx 1$

water:  $n = 1.3$  ( $\approx \frac{4}{3}$ )

glass:  $n = 1.4 - 1.6$  ( $\approx \frac{3}{2}$ )

diamond:  $n = 2.4$

(light loses  $1 - \frac{1}{2.4}$

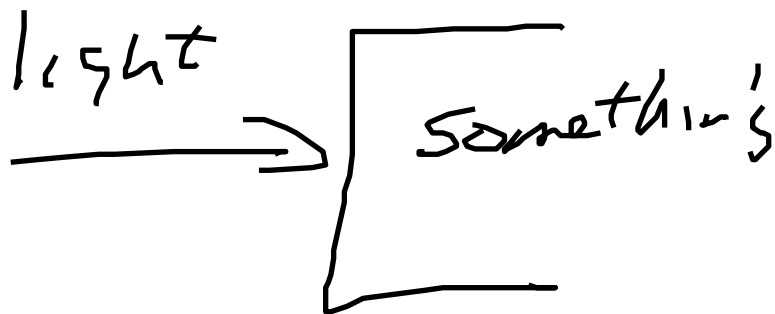
$= 60\%$  of its

speed in diamond)

# "NIL" for Light

Light travels in a straight line at a constant speed until it hits something that changes its speed.

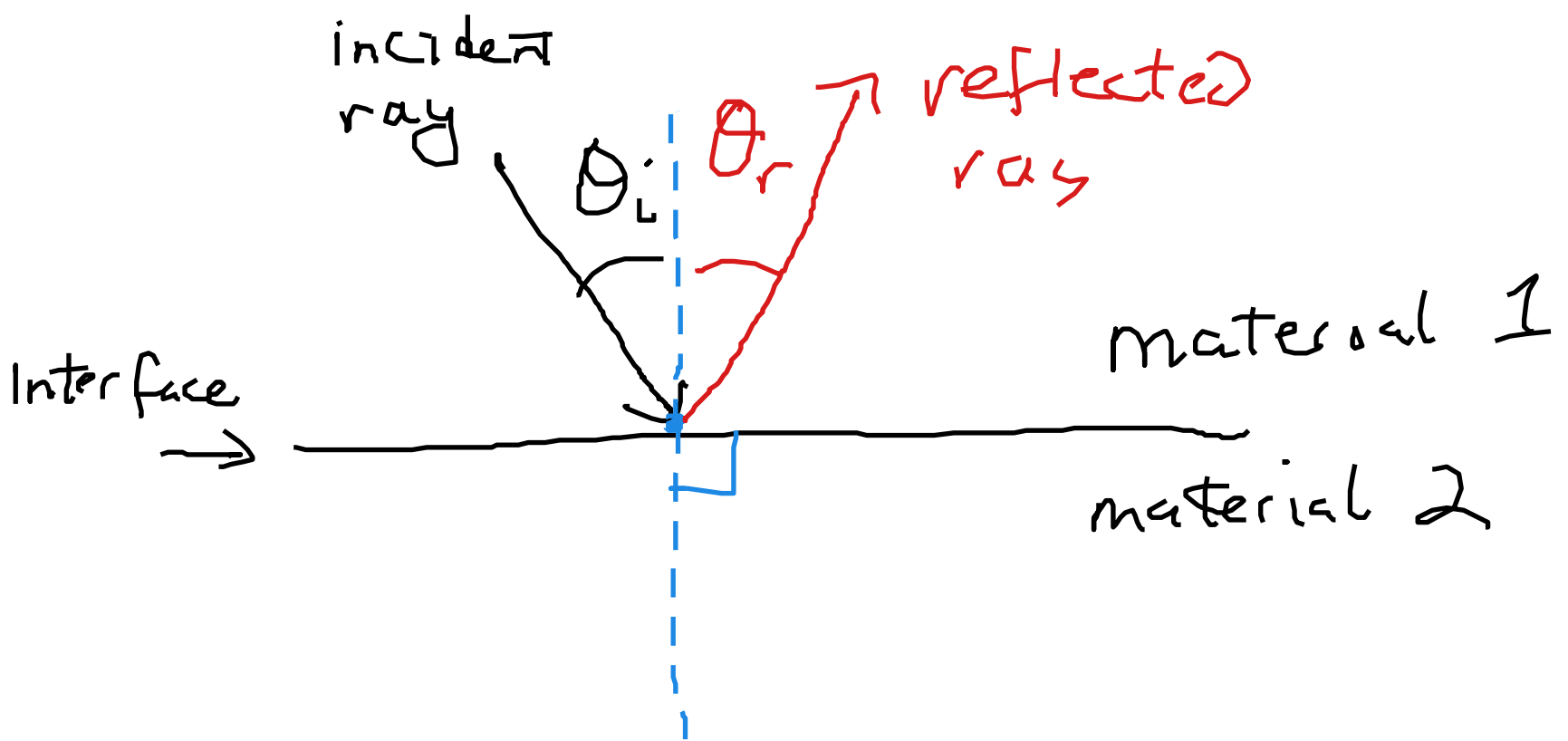
\* something = physical object, not more light



- 1) absorption (disappears)
- 2) reflection (bounces off)
- 3) transmission (passes into)



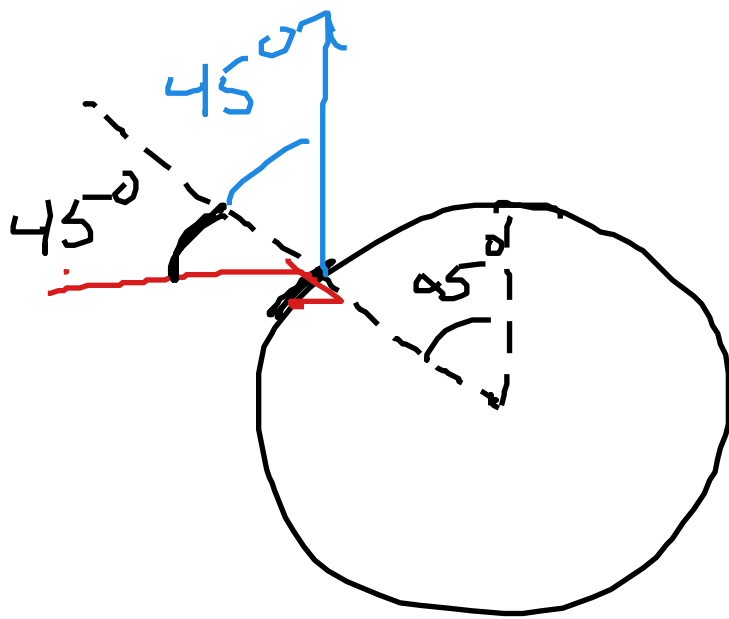
# Reflection



normal  
(= "perpendicular")

Law of Reflection:  $\theta_r = \theta_i$

Angles always measured  
from the normal.



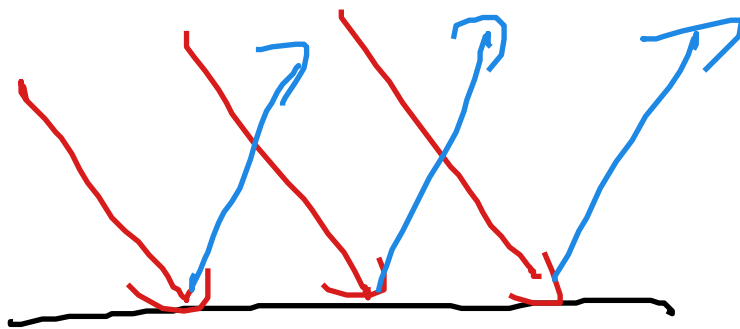
Reflected ray is on the opposite side of the normal from the incident ray.

$$\theta_i = \theta_r = 0^\circ$$

# Specular Reflection

- flat surface

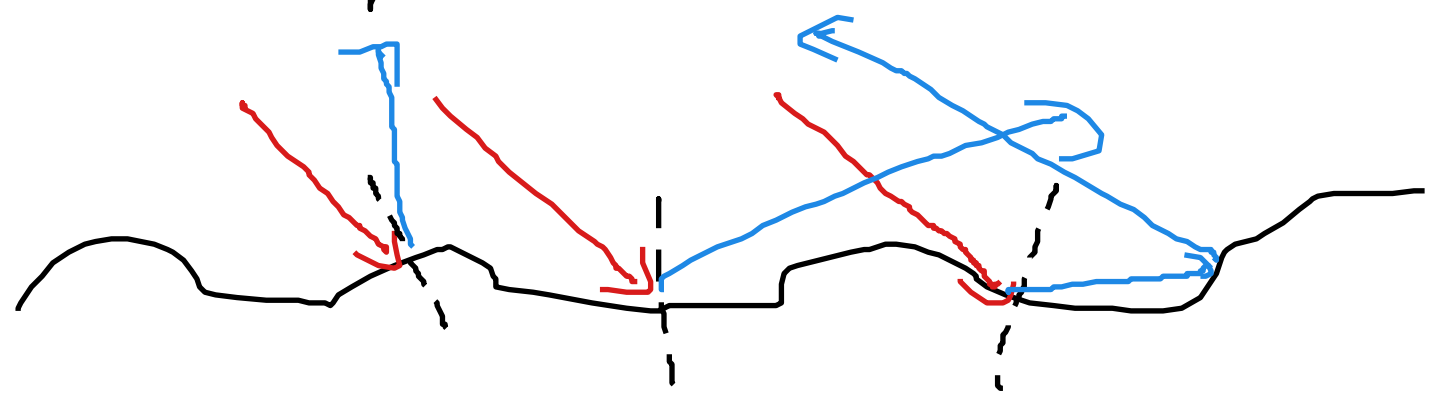
(mirror, calm pond)



reflected rays look  
just like incident  
rays - see images

# Diffuse Reflection

bumpy surface



Rays become disorganized