

Partial Reflection



National Science Foundation
WHERE DISCOVERIES BEGIN

Partially Reflecting Surfaces

Water and glass are mostly transparent but reflect some of the light striking their surface.



Can see some of the riverbed through the water surface.



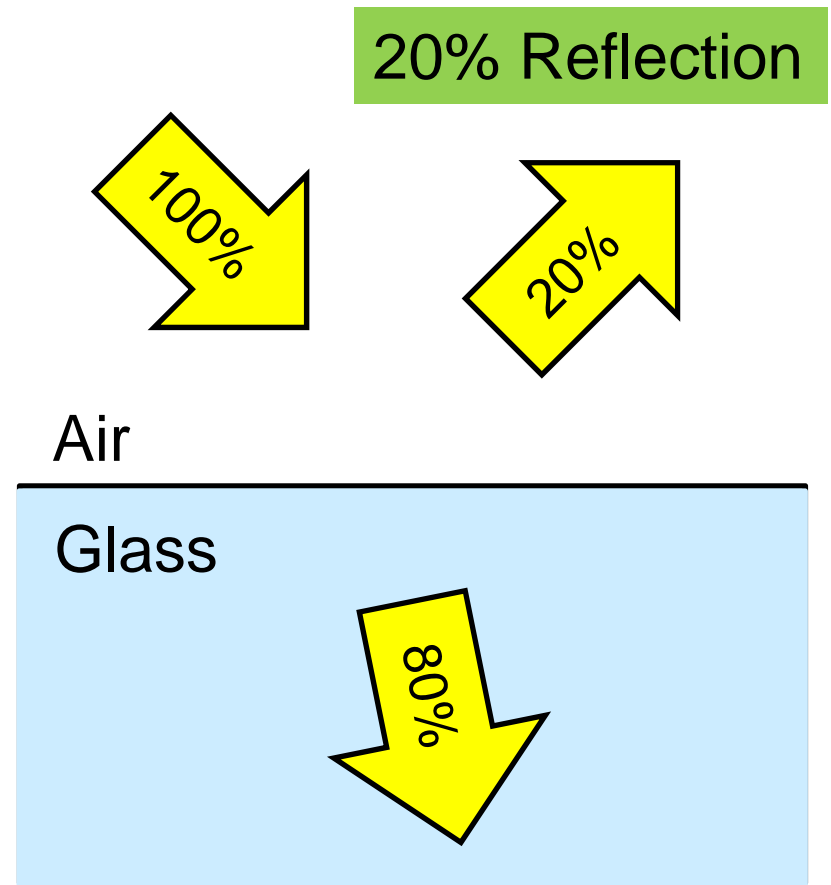
Can see inside the cab through the right window. Strong reflection of the sun on the left window.

Reflection Coefficient

Reflection coefficient is the percentage of the incident light that is reflected at the surface.

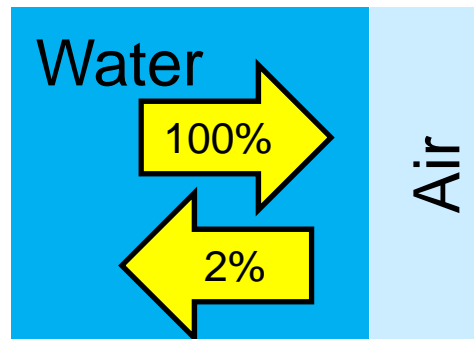
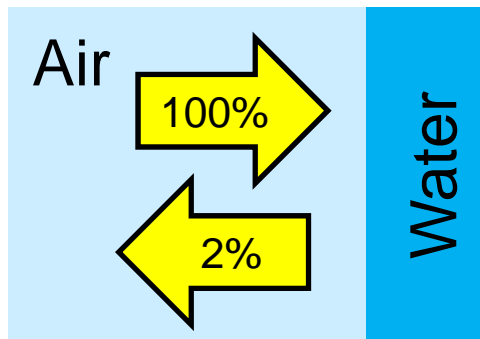
Reflection coefficient depends on:

- Interface materials
- Angle of incidence

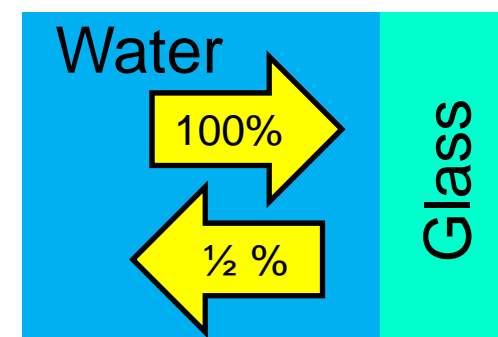
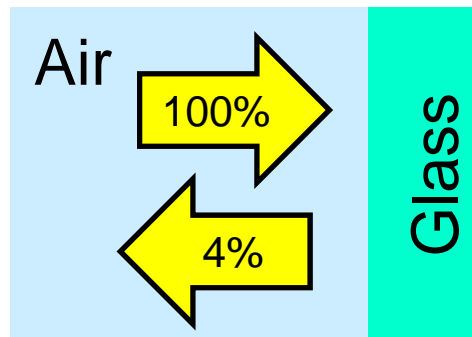
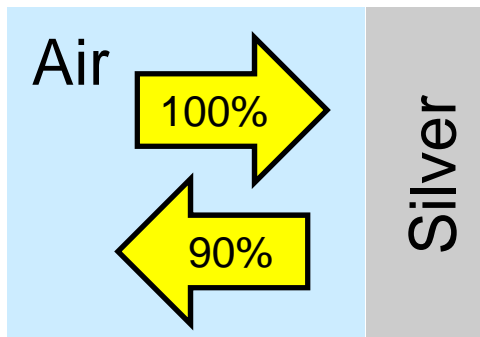


Direct Incidence Reflection

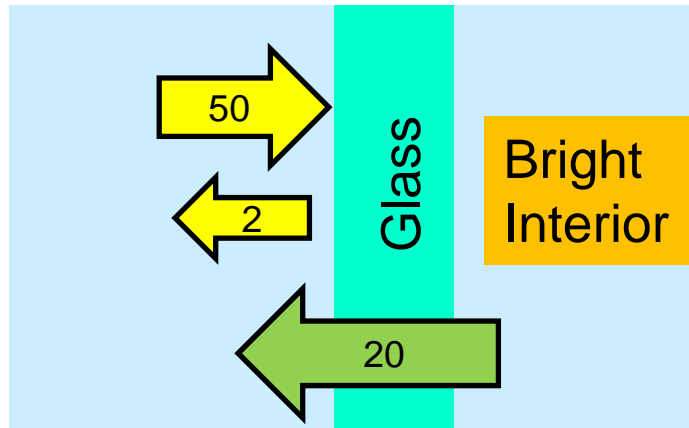
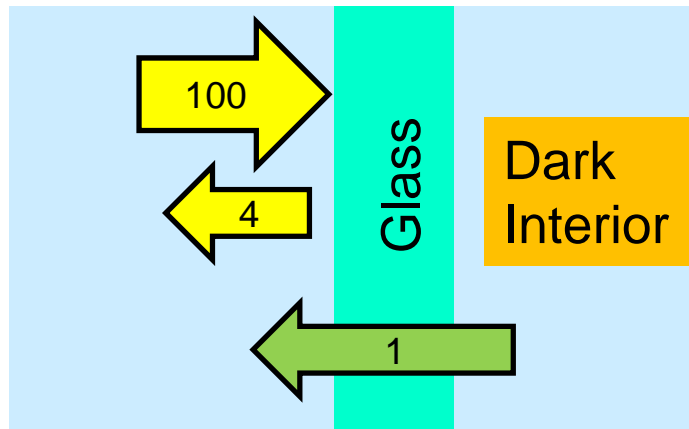
These are the reflection coefficients for direct incidence (head on, zero degrees).



Note: Reflection coefficient does *not* depend on which side the light comes from.



Looking in Windows



Bright Sky &
Dark Interior:
Reflection is
brighter than
Transmission

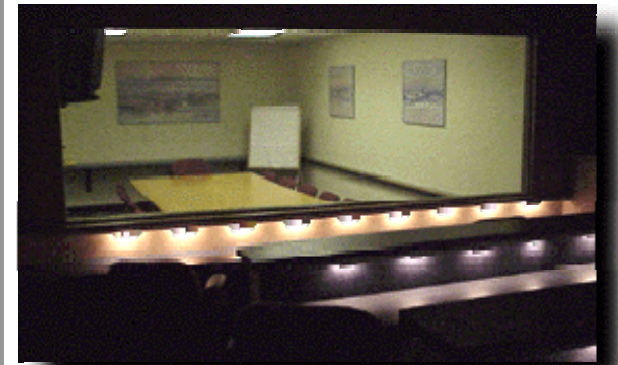
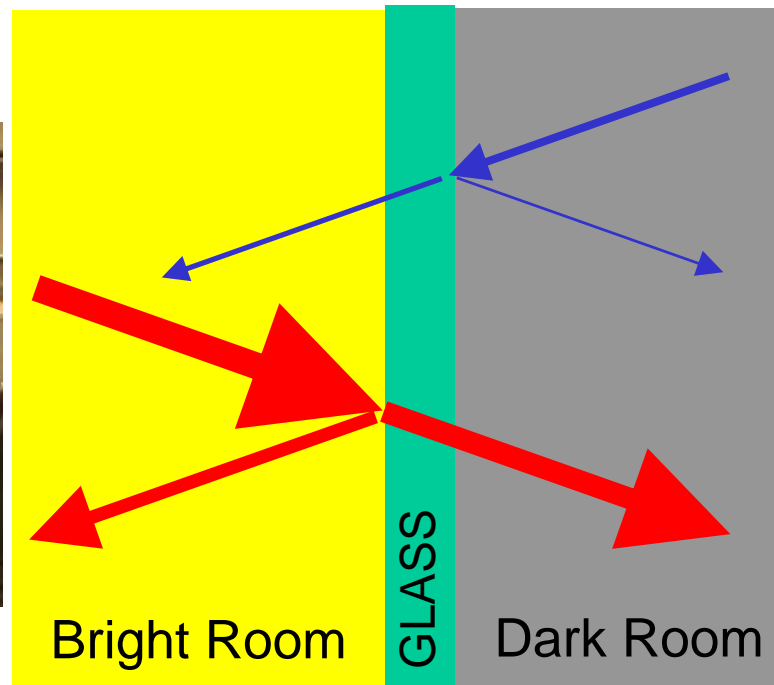
Bright Interior
& Dark Street:
Transmission
brighter than
Reflection

One Way Mirror

Reflected light from bright room masks the transmitted light from darkened observation room.

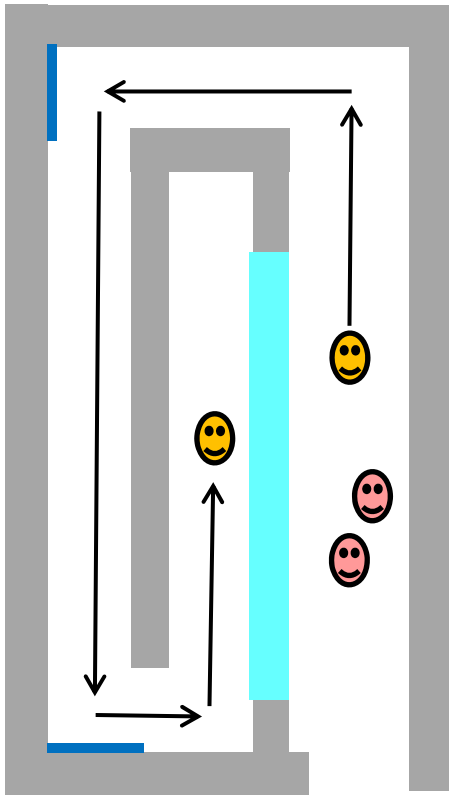


Discussion
Room (Bright)



Observation
Room (Dark)

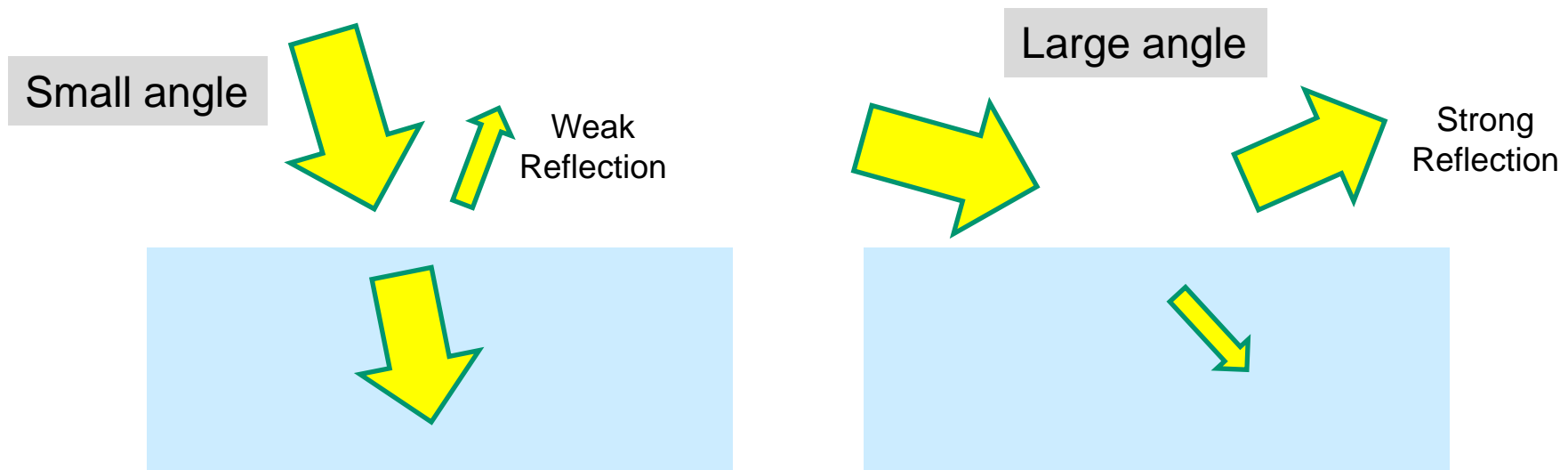
Ken Lum's One Way Mirror



Art piece based on one way mirror.

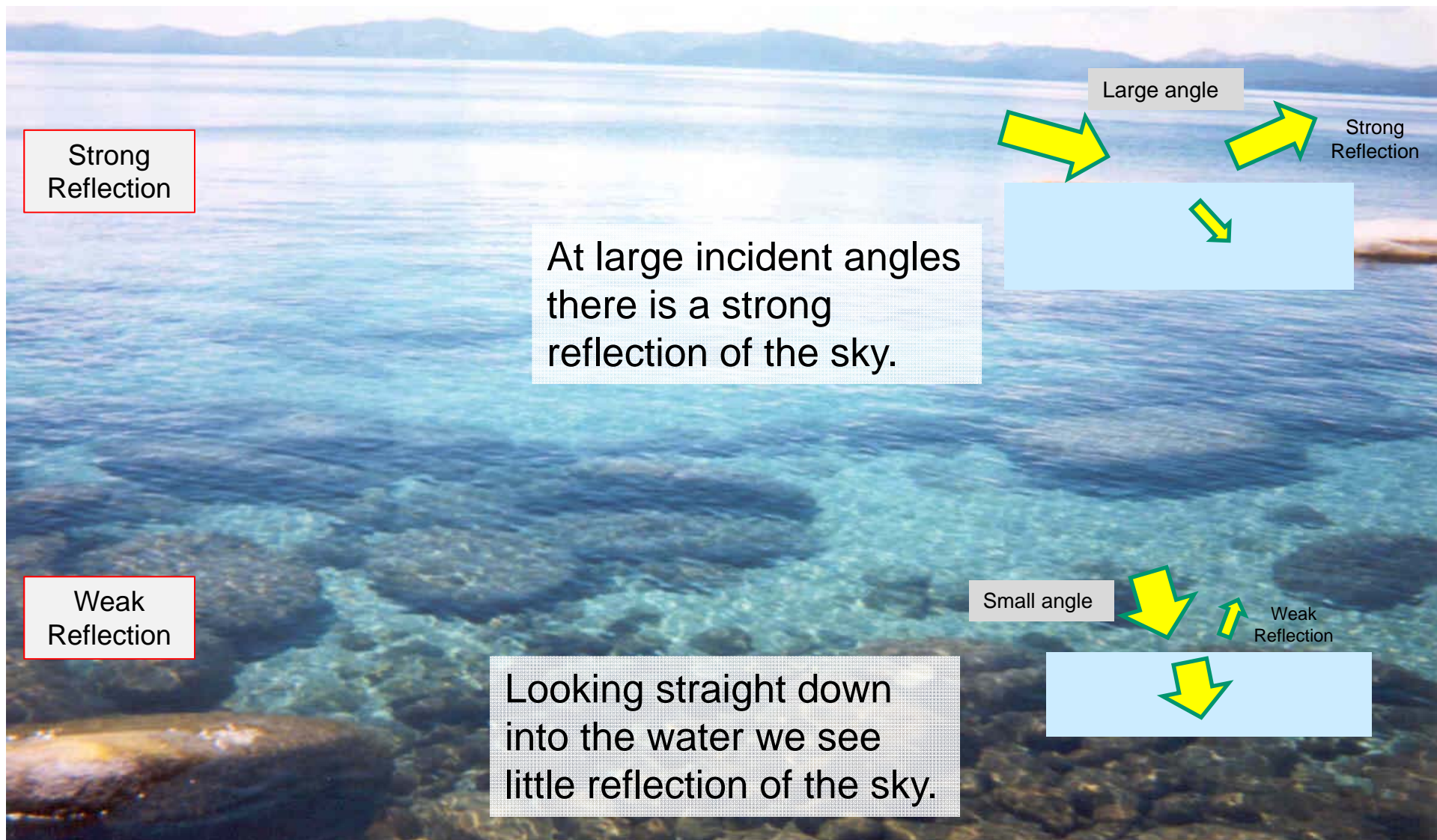
Reflection Coefficient & Angle

Reflection coefficient increases as the angle of incidence increases.

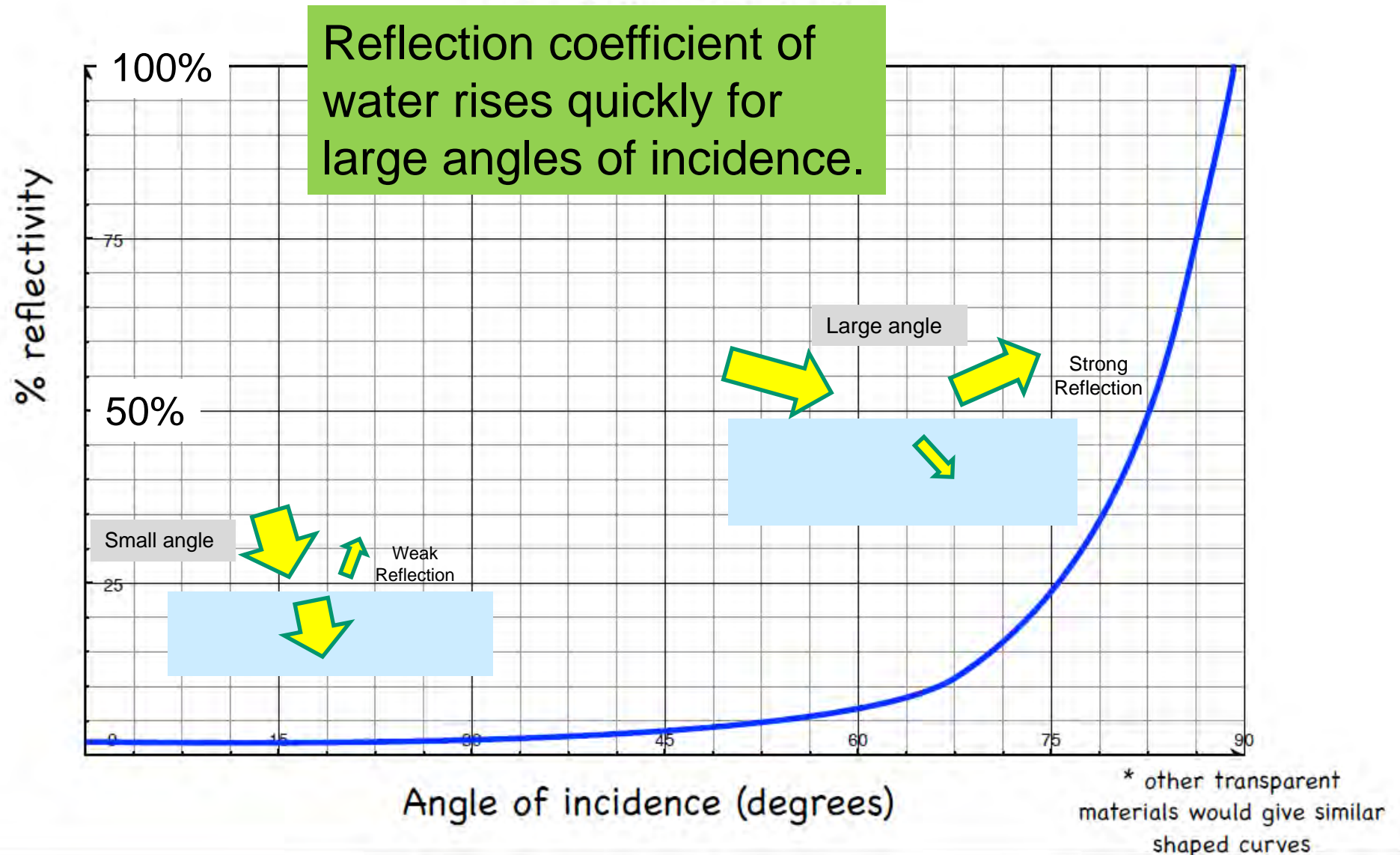


The dependence of reflection on angle is sometimes called the *Fresnel effect*.

Fresnel Effect on Water



Fresnel Effect for Water

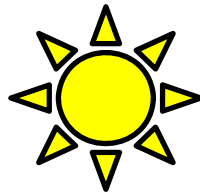


Fresnel Effect on Glass

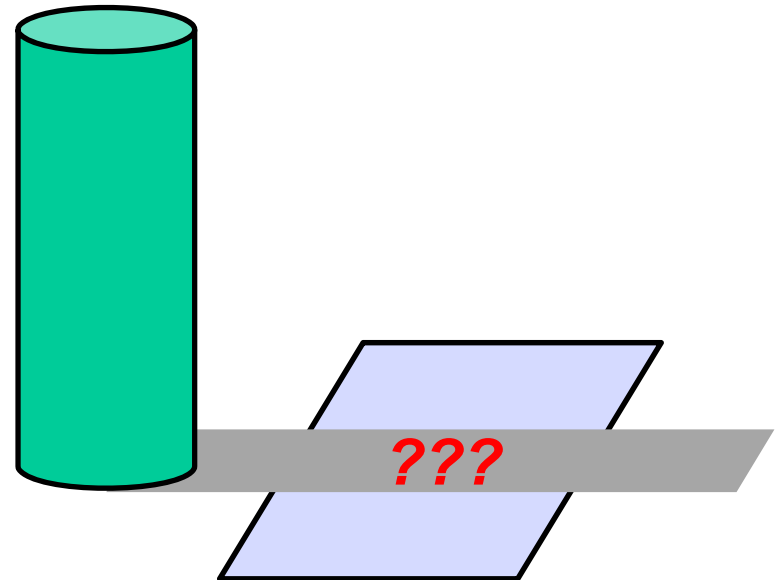


Shadows & Reflection

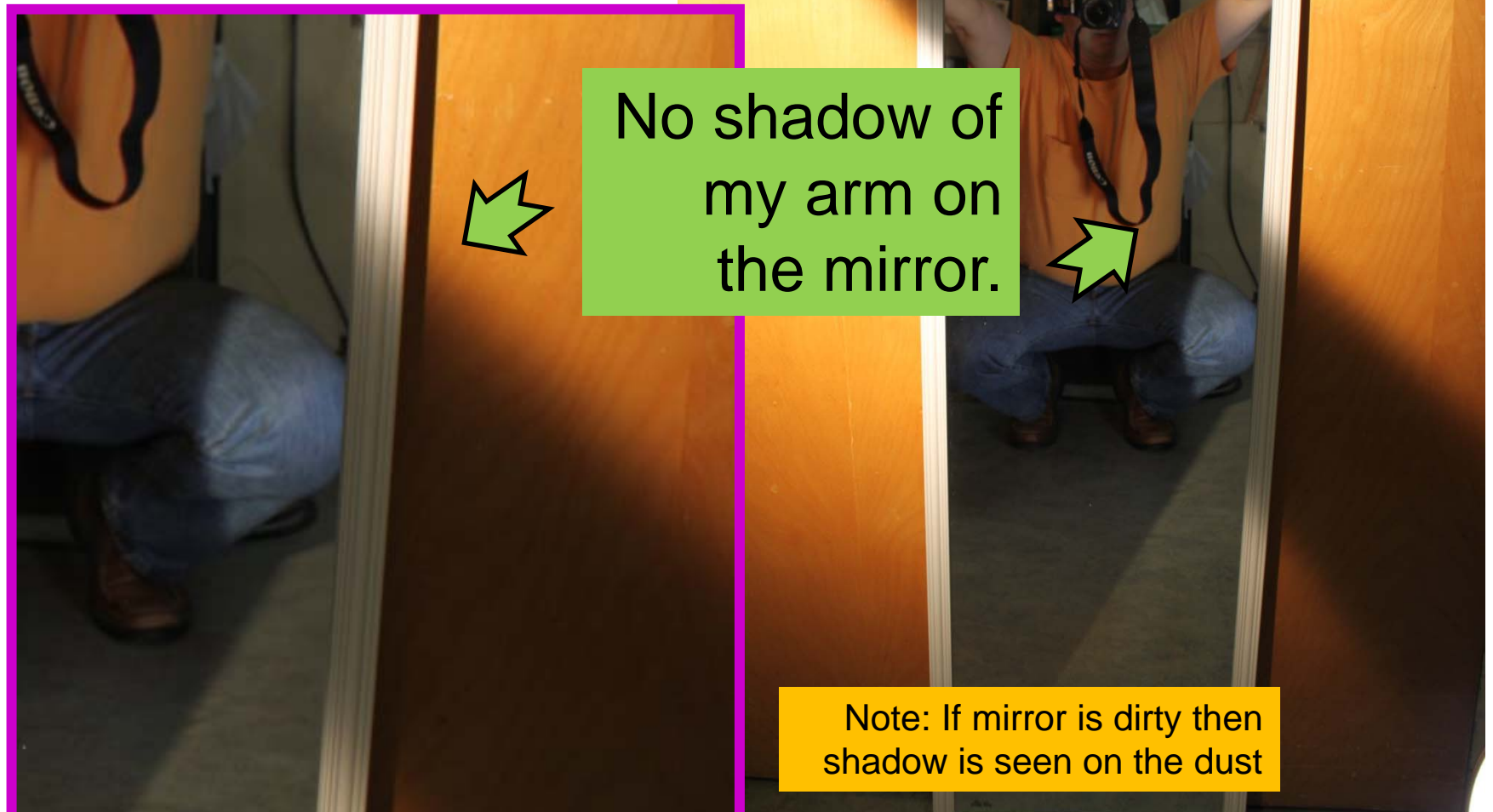
Can you cast a shadow on a reflecting surface, such as a mirror?



Can you cast a shadow
on a clear water?
On murky water?



Shadows & Mirrors



Shadows in Water



For the clear water the shadows are cast on the bottom of the pool



In muddy water the shadows are cast on the surface

Clean Water versus Muddy Water

Weak reflection on
calm, flat water



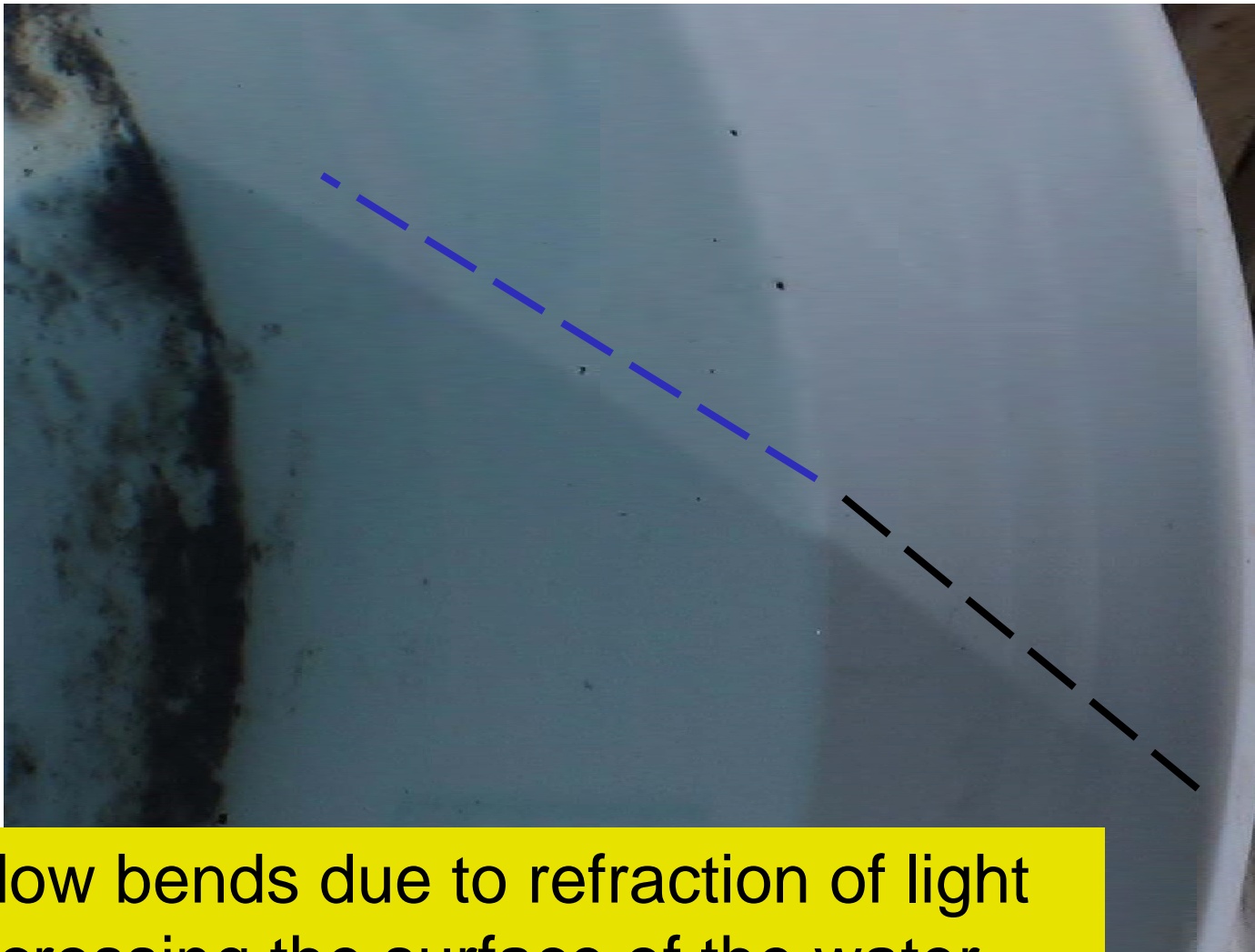
Cast shadow
on bottom

Strong reflection
and highlight



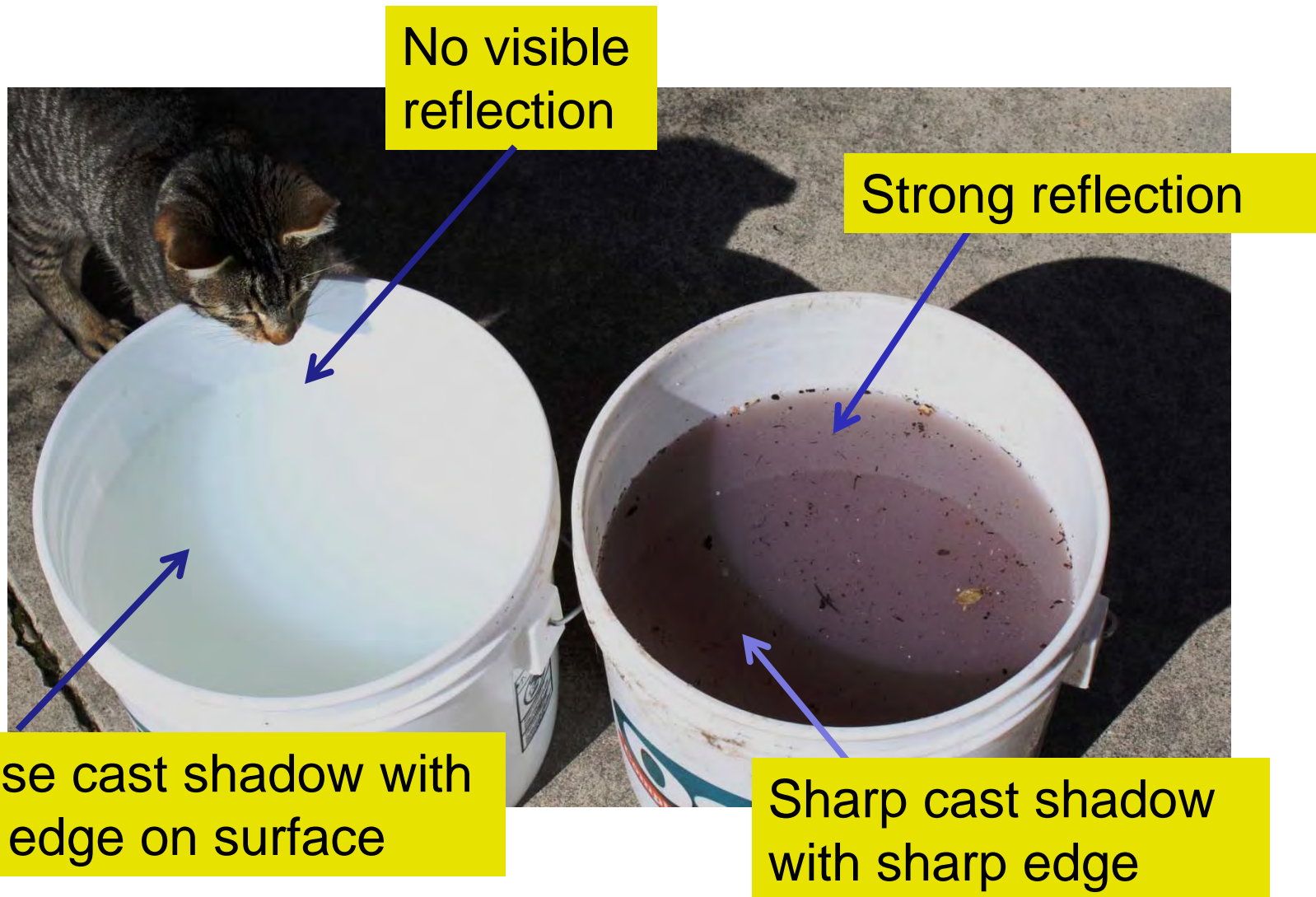
Cast shadow
on surface

Refraction of Shadow



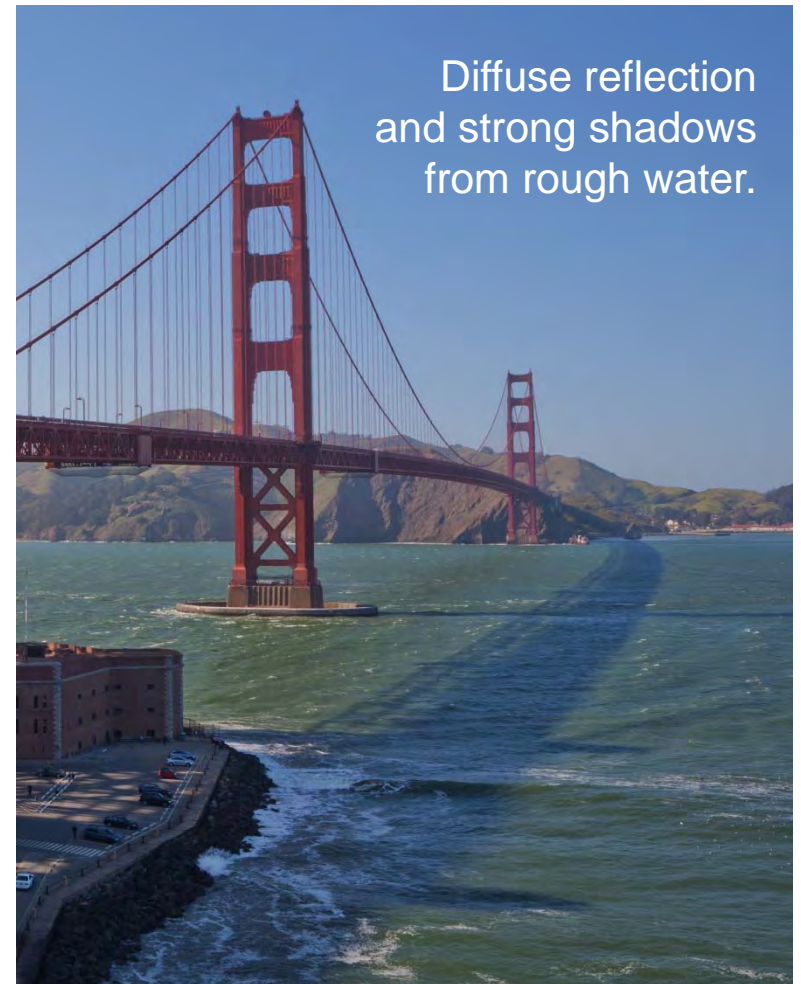
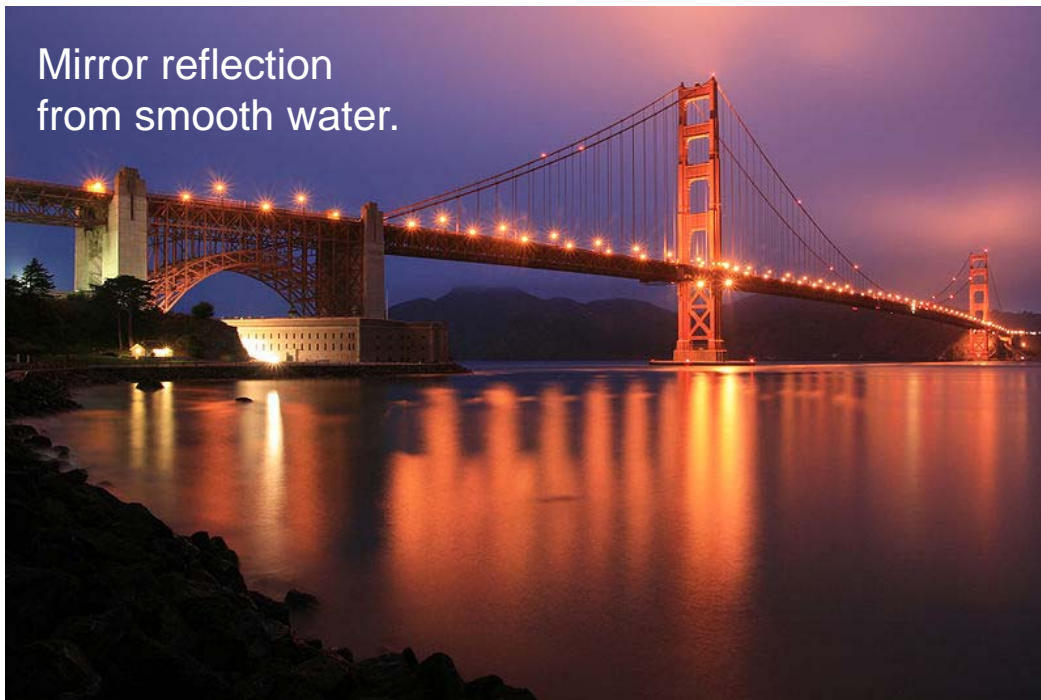
Shadow bends due to refraction of light rays crossing the surface of the water.

Milky Water versus Muddy Water



Smooth Water vs. Rough Water

Reflections and shadows on water also depend on the surface's smoothness.



Photos from wikimedia

Summary

- Reflection coefficient is percentage of the incident light reflected at the surface.
- Reflection coefficient depends on the materials and the angle of incidence.
- Glass and water look transparent or reflective depending on the brightness.
- Reflection coefficient increases as the incident angle increases (Fresnel effect).
- Shadows and reflections on water depend on the surface's clarity and smoothness.