21.Light-Matter Interactions

Monday, November 4, 2024 2:55 PM

Today

Admin:

- Reading assignment: Guidebook, Dye Techniques 1 Do Not Disturb and 2 High Visibility

SPECIFIC FV techniques

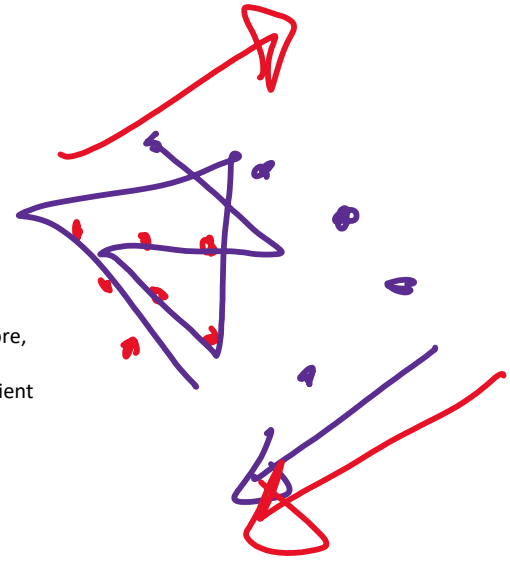
Boundary techniques. Boundary between 'seeded' and unseeded fluid.
Choice depends on physics desired
I DYES **Today**. Mostly in water.
Light/matter interactions in general
2 Particles. In air (aerosols, fog, smoke)
3 Particles in water
4 Light emitting fluids
5 Index of refraction techniques

Background music in class
Silly icebreaker for all

How to not disturb flow

Match conditions, be careful of dye injection location
Match fluid properties

Match diffusion coefficient?
Think Pair Share: What is diffusion? What causes it?



Something to do with entropy
Concentration gradient - movement from high to low
Transport equations Navier Stokes
Intermolecular forces
Molecules have chaotic collisions
Release energy from random movements
Molecules in solids have low energy, wiggle a little. Liquids have more and move more, gasses move a lot.
Particles are in constant random motion due to thermal energy. Concentration gradient and thermal equilibrium.
Random walk

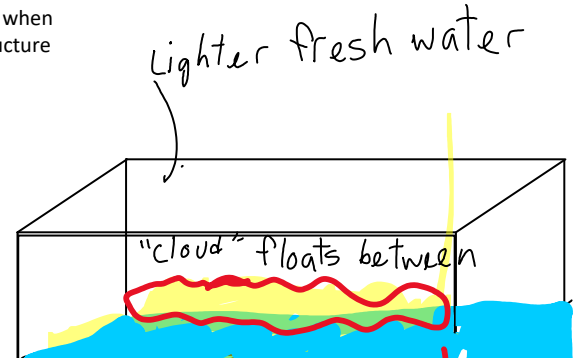
From the *atomistic point of view*, diffusion is considered as a result of the random walk of the diffusing particles. In molecular diffusion, the moving molecules are self-propelled by thermal energy. Random walk of small particles in suspension in a fluid was discovered in 1827 by Robert Brown, who found that minute particle suspended in a liquid medium and just large enough to be visible under an optical microscope exhibit a rapid and continually irregular motion of particles known as Brownian movement. The theory of the Brownian motion and the atomistic backgrounds of diffusion were developed by Albert Einstein.[5] The concept of diffusion is typically applied to any subject matter involving random walks in ensembles of individuals.

From <https://en.wikipedia.org/wiki/Diffusion>

Diffusion can be modeled and computed using concepts of concentration gradient, Gibbs free energy, Fick's Law, etc.

The diffusion coefficient of dye is higher than water, causing dye to diffuse too rapidly, misleading when studying mixing. **Turbulence** also causes fast diffusion, making visualization of the overall flow structure difficult. **Try some milk or latex paint to slow turbulent diffusion.**

Famous boundary technique example:



Cloud tank was invented by Douglas Trumbull to make realistic clouds in 'Close encounters of the third kind' (1980's sci fi). Used many times since
https://www.youtube.com/watch?v=pYVybOyMz-A

"The effect's process begins with filling a water tank halfway with saltwater which is then layered with a thin plastic sheet. Fresh water is poured over the thin layer of plastic to fill the rest of the tank. This leaves the visual effects artist to remove the thin layer of plastic to

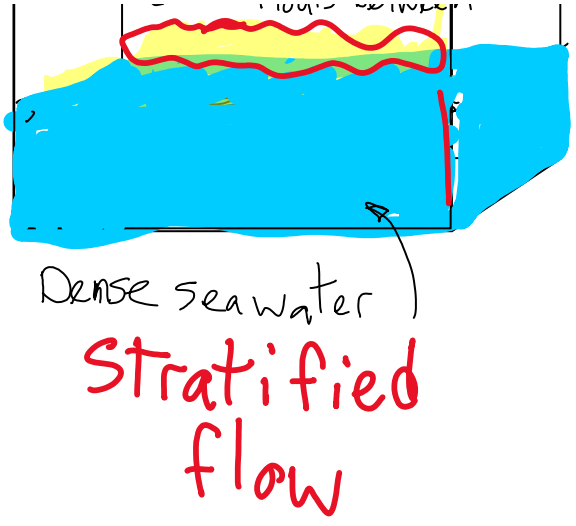
"The effect's process begins with filling a water tank halfway with saltwater which is then layered with a thin plastic sheet. Fresh water is poured over the thin layer of plastic to fill the rest of the tank. This leaves the visual effects artist to remove the thin layer of plastic to reveal what seems to be a single body of water, but is really two layers of different densities: salt water and fresh water. Finally, paint is injected into the tank and it flows through the water, forming an organic cloud figure…
A 2000 gallon glass tank was used that was approximately seven feet tall, seven feet wide and four feet horizontally which would have to be emptied and refilled after every shot."

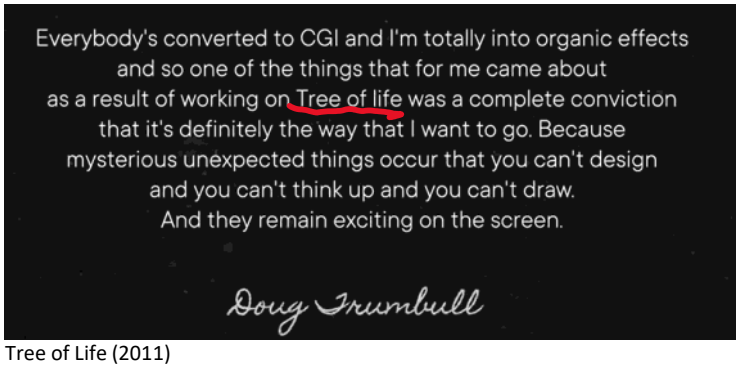
From <https://donofriofilm.wordpress.com/2013/12/16/cloud-tank-effects/comment-page-1/> references
http://singlemindedmovieblog.blogspot.com/2010/04/old-school-effects-cloud-tank.html

DIY version: http://www.youtube.com/watch?v=hxgVKWe5Vm0

Also used in
Raiders of the Lost Ark (1981), Star Trek: The Wrath of Khan (1982) and Independence Day (1996)

From <https://www.flowvis.org/Flow%20Vis%20Guide/do-not-disturb-dyes-in-liquids/>





Tree of Life (2011)
From
Cloud Tanks - Explain like I'm five, VFX edition: E01
Dimitris Katsafouros
https://www.youtube.com/watch?v=qIYAvHsojDk, a detailed vlog episode on cloud tanks

Would be great to try with our new city models from Mark Stock! See me for checkout.

2)Want dye to show up - HIGH VISIBILITY

High Visibility: Want good contrast between dyed and ambient fluid.

Ambient fluid = transparent = NO interaction with light
Dyed fluid = want MAXIMUM interaction with light
Example: Alberto Seveso:
https://www.behance.net/gallery/64228035/Untitled-42

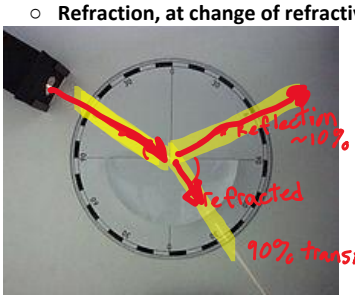
In groups, clicker short answer
list the ways that dye (or any molecule) can interact with light (from external source, later will talk about emitted light)

Refraction
Reflection
Diffraction
Absorption
Emission
Transmission
Diffusion
Double reflection

Refraction
Absorption
Diffraction
Reflection
Scattering/diffusion
Transmission
Dispersion

Emission
Fluorescence
Excitation

1) **Transmission**
   - **Refraction, at change of refractive index**

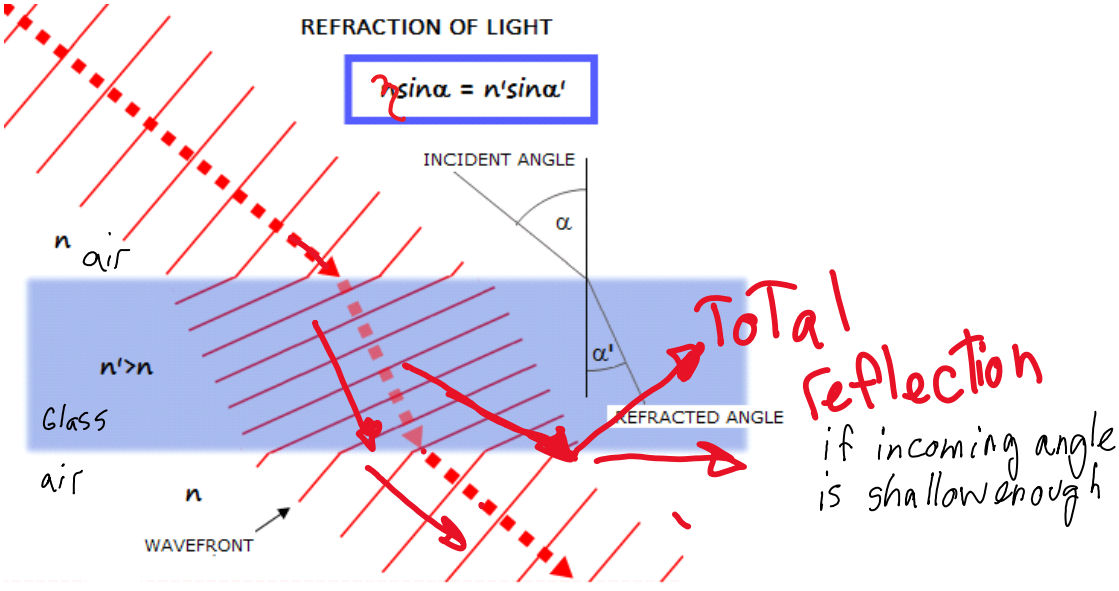


Lecture 02 Overview2
Snell's law

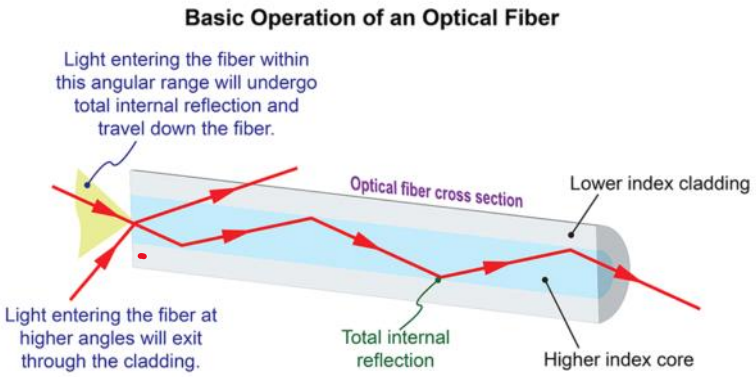
http://upload.wikimedia.org/wikipedia/commons/thumb/1/13/F%C3%A9nyt%C3%B6r%C3%A9s.jpg/220px-F%C3%A9nyt%C3%B6r%C3%A9s.jpg

There are many flow vis techniques based on refraction; will cover later.

$$\eta = \frac{c_{vac}}{c_{medium}} > 1$$



How fiber optics work: total internal reflection, 100% light transmission if incident angle is greater than critical angle (shallow compared to surface, large compared to surface normal). Glass core is surrounded by cladding, doped glass with lower refractive index. No data loss, and light is faster than electrons.



https://www.coherent.com/news/glossary/optical-fibers