18.Dyes2

Monday, February 28, 2011
12:26 PM

Don't forget to spell check your reports
Invite friends, family to Lobby Show 5/4, 2 pm-4pm. Help set up at 1 pm

I) Dye Considerations:

1)Want dye to NOT disturb flow

The concentration gradient between dyed and undyed fluid may cause 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 diffusion.
Famous example:

Cloud tank was invented by Douglas Trumball to make realistic clouds in 'Close encounters of the third kind' (1980's sci fi). Used many times since:
http://www.youtube.com/watch?v=2Ps0iXwS60E

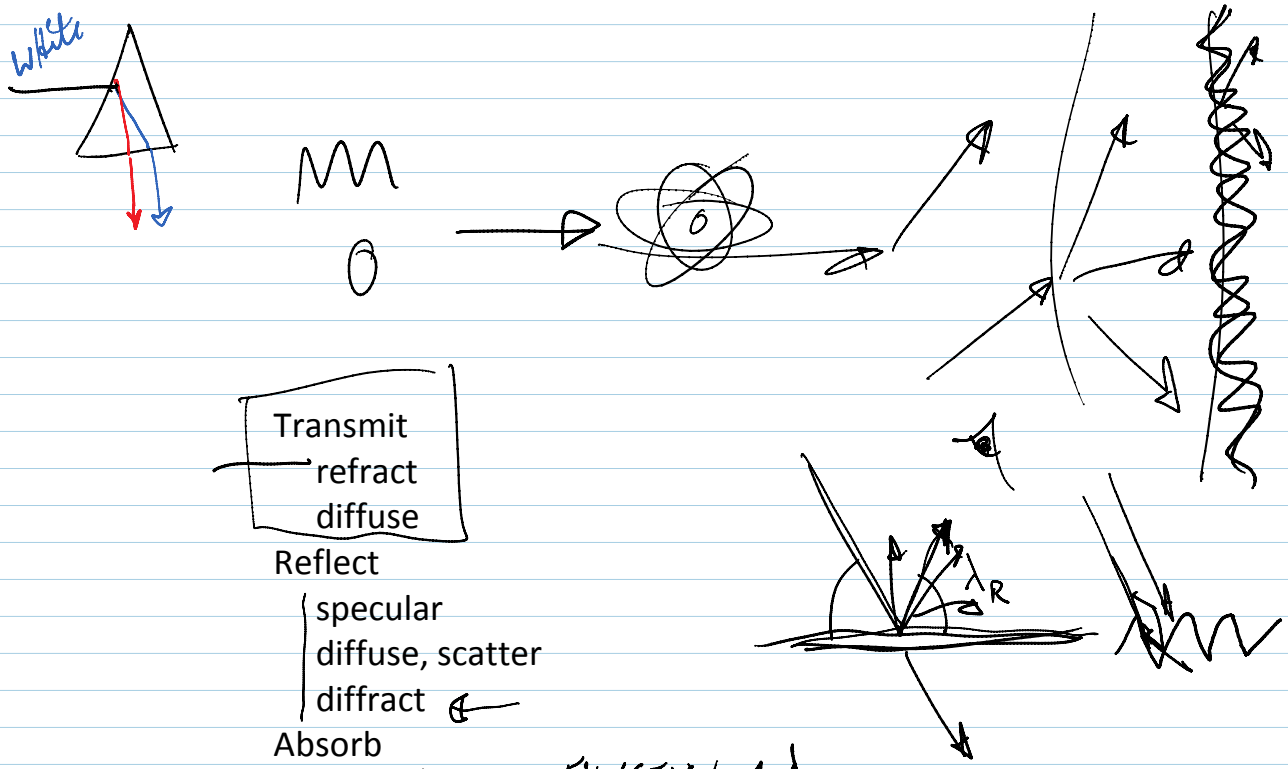
More info in Special Effects article
http://www.americanheritage.com/articles/magazine/it/2007/1/2007_1_10.shtml

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

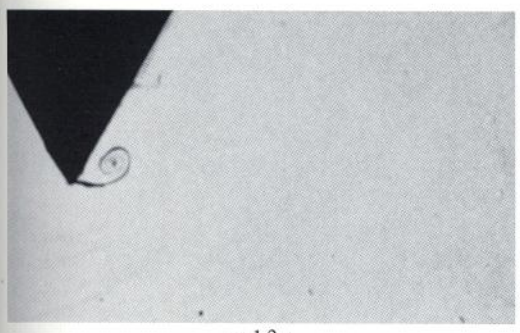
Minute paper: list the ways that dye can interact with light



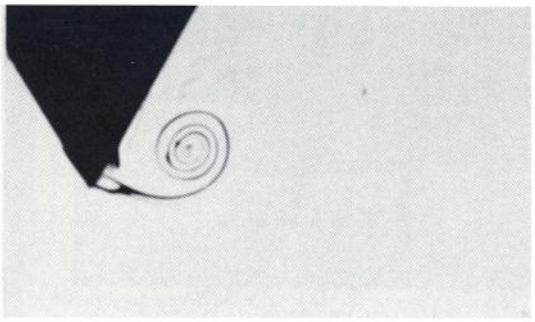
Huygen's principle
Waves spread from 2 holes, interfere

Example of diffraction grating: CD or DVD

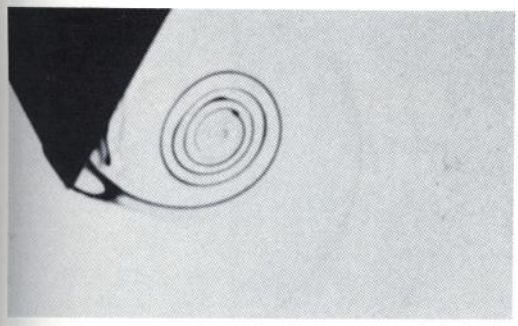
Make sure lighting and backdrop are appropriate for the type of light interaction.



$t=1.0$ s



3.0 s



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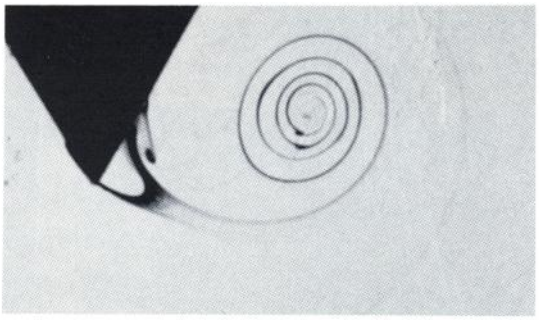
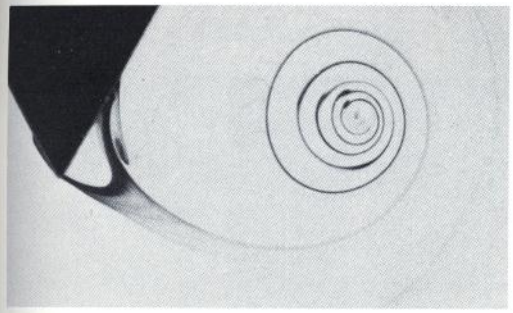
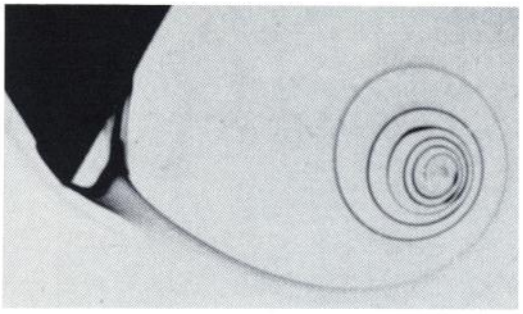


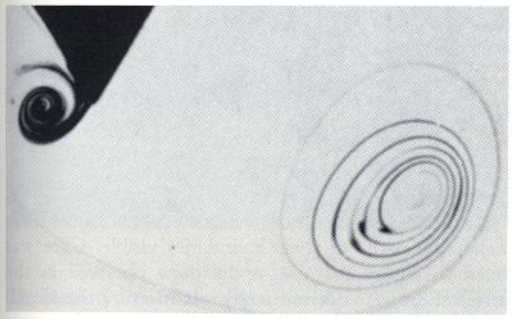
7.0 s



$t=9.0$ s



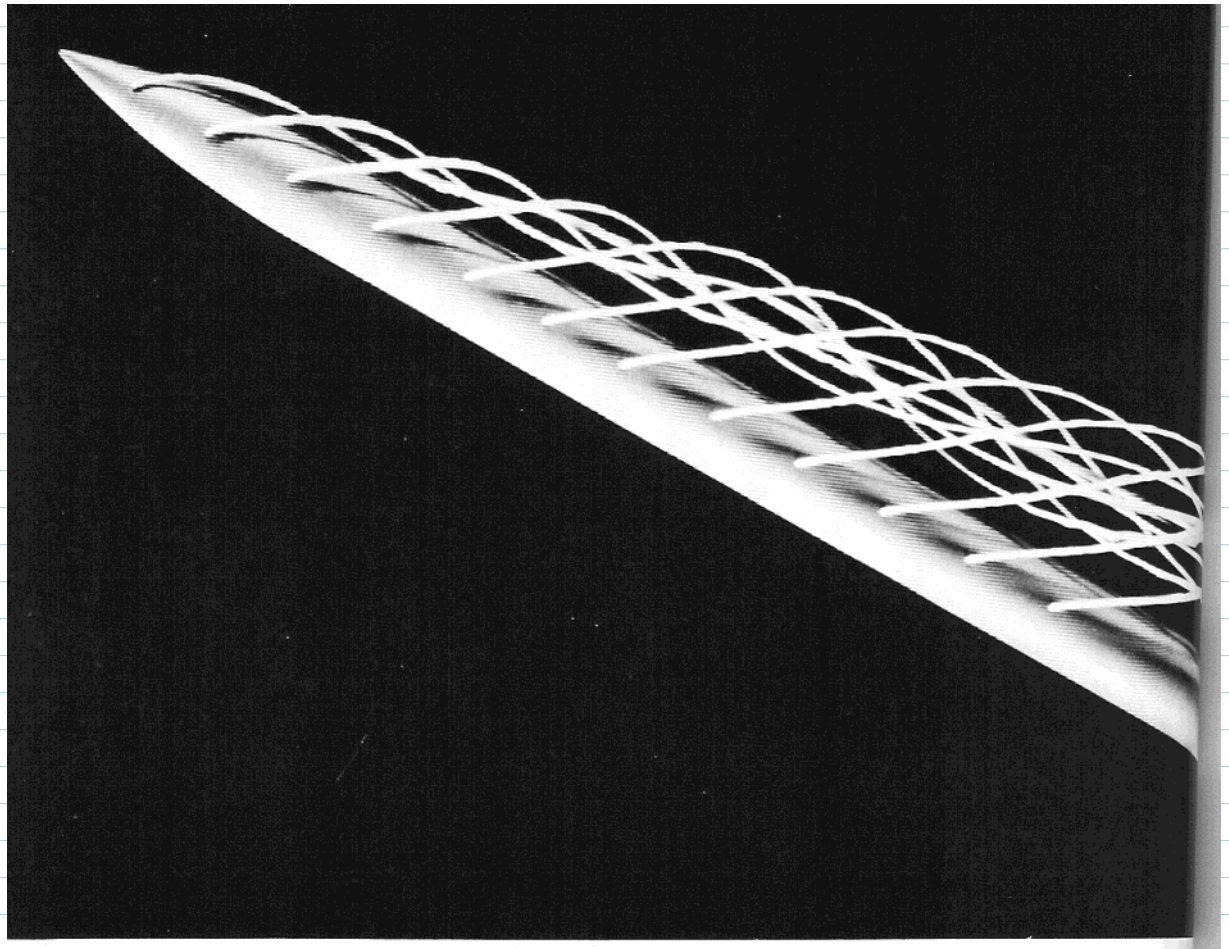
11.0 s



$t=13.0$ s

80. Starting vortex on a wedge. A piston drives water with almost constant speed normal to the axis of a wedge of 30° semi-vertex angle. Neutrally buoyant dye is injected into the water from small holes in the wedge surface. The characteristic Reynolds number is of order 1000. The piston stops at 12.5 s, producing a stopping vortex in the last photograph. *Pullin & Perry 1980*

REFLECTION



REFLECTION

SPECULAR

DIFFUSE

87. Attached vortex pair behind an inclined slender body. A long ogive-cylinder is inclined at 30° to water flowing at 4 cm/s. At this angle of attack a symmetric pair of vortices forms on the lee side of the body. Colored fluid emitted under slight pressure from 0.3-mm holes spirals around the core of the nearer vortex. The Reynolds number is 400 based on the diameter of 1 cm. *Fiechter 1969*

E.g.:

Dye = dark food color. Absorption is primary, so use bright backdrop

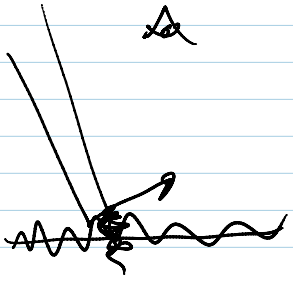
Dye = milk. Scatter is primary; use black backdrop

Minute paper: Which is better for a dark backdrop: smooth or rough?

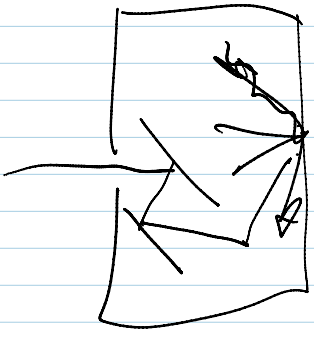
Dark Backdrop

ROUGH
+ trap light
diffuse

SMOOTH
REFLECTION



laser light trap



Smooth is good if you can control what the specular reflection shows. If not, rough is better.

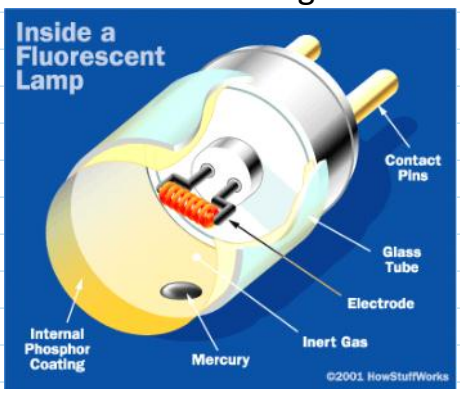
Light Emitting fluids

Black Body Radiation = yellow flame color, from BBR of soot particles. Random λ (wavelength) photons from thermal energy

Luminescence = cold body emission, usually at specific λ.
Fluorescence = absorb at a specific short λ, emit at a longer λ.

E.g. some laundry detergents and fabric softeners absorb in the UV, and emit blue or orange

Fluorescent bulbs: Current is conducted through mercury vapor, energizes it to emit UV photons which hit a phosphor coating on the inside of the tube, which then emits visible light.



http://home.howstuffworks.com/fluorescent-lamp.htm/