01.Intro

Monday, January 13, 2014 4:36 PM

Welcome to Flow Vis!

Today:

- Syllabus
- First Assignments (8? 9!?!)

3 handouts:

1. Syllabus
2. Initial Assignments
3. Copyright Agreement

What is flow visualization? Let's start with an example:

http://www.danielwurtzel.com/air.cfm <file://C:\Users\hertzber\Documents\01CLASSES\FlowVis\MeetingsPapers\58AestheticsDFD2012\WurtzelPas_de_Deux.flv>

Prosaically:

Flow visualization = making the physics of gasses and liquids visible

SYLLABUS

MCEN 4151/5151/ FILM 4200/ ARTF 5200

Flow Visualization: The Physics and Art of Fluid Flow

Fall 2015

Course Overview
Goals

Both science and art can be described as being fundamentally based in our perception of the world around us. In science, clear observations lead to understanding, particularly of physics, which is a prerequisite to successful engineering. In art, creating and influencing our own and others' perception of the work, whatever it may be, is the whole point. Art may also be defined as an execution of a vision; an instantiation of an idea, 'making it so'. In this course we will focus on making the physics of fluid flow more available to perception, specifically, in a word, visible. You may also find that your perception of fluid flow in everyday life has been sharpened. In the process we will be creating both art and science.

Flow visualization is particularly suited to the interface between art and science. Many fluid physicists are motivated not only by the important scientific and engineering goals of their work, but also by a visceral fascination with their subject. Few scientists or engineers admit as much, but the existence of several venues for display of fluid flow art belies purely dispassionate motivations. Foremost among these venues is the Gallery of Fluid Motion [1], a poster and video competition which held in conjunction with the American Physical Society Division of Fluid Dynamics (APS-DFD) annual fall meeting. Gallery entries are judged "based upon criteria of scientific merit, originality, and artistry/aesthetic appeal." Winners are published in a peer-reviewed journal, *Physics of Fluids,* and winners have been recently collected into a volume [2]. (Some winners were works from this course.) A recent New York Times article [3] about the Gallery attests to the potential for general impact on students and the public. Additional examples include the seminal *Album of Fluid Motion* [4], which can be found on the bookshelf of nearly every fluid dynamics researcher, and the recent *Multi-Media Fluid Mechanics CD-ROM* [5]. In each of these examples, the sheer beauty of fluid flow is revealed and acknowledged to some extent. Thus we hope to encourage engineering students to gain a deeper perception of fluid flow by capitalizing on this previously unacknowledged motivation, that is, for aesthetic and creative purposes. In the case of art and other non-engineering students, our goal is to introduce students to the simple beauty and fascination of fluid flow, as well as a bit of exposure to the discipline of documented experimentation.

Another goal of this course is to give you a chance to work with students from different disciplines. Art and engineering students have been trained with different approaches and values. In this course you will work with a range of colleagues, and discover your differences and similarities. Hopefully, you'll see value in the range of perspectives.

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1. http://www.aps.org/units/dfd/.
2. Saminy M, Breuer K, Leal G, Steen P. *A Gallery of Fluid Motion*, Cambridge University Press, 2003.
3. Schechter B. "From flowing fluids, beautiful images and unlocked secrets," *New York Times,* June 24, 2003.
4. Van Dyke ed. *An Album of Fluid Motion*. Parabolic Press, 1982.
5. G. M. Homsy, *Multimedia Fluid Mechanics DVD-ROM*, 2nd ed. (Cambridge University Press, 2008).

It seems that imaging (including both still and motion photography/video) provides us with a crucial model of an art and a science that provides a bridge between the quite different worlds and roles of the artist and scientist. What is the role of photography in the cultural assimilation of technology and the popularization of experimental science? What is the future of an aesthetic of scientific imagery? Is an aesthetic of beauty appropriate or even desirable for the consideration of scientific imagery? If so, in what cases and why? Are there aesthetic approaches other than considerations of beauty that come into play in the processes of aesthetization ("museumization")? Fluid physics are responsible for a wide range of natural disasters; floods, tornadoes and wildfires, for example. Videos of such disasters are very popular, raising the question of an aesthetic of destruction. How can these aesthetic processes be characterized? And, finally, what are the relationships between art and science that we can learn from this course?

Course Format

The course will consist of lectures on visualization techniques, fluid physics, critique sessions, and a guest lecture. Emphasis will be placed on the production and critique of student images; there will be six assignments consisting of an image or video, and an accompanying report. A final showing will be produced in the Engineering Center Lobby and students will be encouraged to submit work to the American Physical Society's Gallery of Fluid Motion annual competition, as well as other art/science competitions. There are no formal lab sessions; instead students are expected to treat assignments as they would for any other course. **Team members are expected to make effort to meet with their teams outside of class**. **Students are expected to attend all critique sessions,** and bring their laptops or smartphones to offer online (in D2L), anonymous comments on each image.

Course Content

This course will reveal the techniques of making laboratory and everyday fluid flows visible for both scientific and aesthetic purposes. Students will create images using photographic and video techniques, and document their work in written reports. Questions such as "what makes an image scientific? What makes an image art?" will be explored, but this is largely a technical course. Students will also gain technical expertise in a range of flow visualization and photographic techniques drawn from the following list. Quantitative applications and analysis will be considered where appropriate.

Partial lists:

Possible fluid media:

- liquid dye or particles in water
- smoke or fog in air
- water in air; sprays, clouds, free surface waves
- temperature or concentration gradients in air and water
- many combinations of everyday fluids such as milk, vegetable oil, alcohol, shampoo, etc. **Caution, do not combine anything with a bleach product.**

Fluid phenomena:

Wakes
Jets
Shear layers
Vortex rings
Buoyancy induced flows
Surface tension driven flows
Two phase flows (fountains, bubbles, sprays)
Laminar or turbulent flow
Immiscible effects
Combusting flows. **See posted safety guidelines for working with flames.**
Ultrasonic driven flows (fountain/fog generators)

Visualization techniques:

Laser sheet visualization
Particle image velocimetry
Stroboscopic volume visualization
Schlieren/ shadowgraph techniques
Oil flow techniques (wind tunnel applications)
Thermal and pressure sensitive paints

Imaging techniques:

Photography (digital or film, stereo or mono)
Video/movies (analog, digital or film)

Post processing of above.

Safety Considerations: If you want to work with combustion, you must follow the combustion guidelines posted on the website. When working with household materials, you are pretty safe if you stick to personal hygiene (i.e. soaps and shampoos) and food products. If you are working with cleaning or medical products, or lab chemicals, you must discuss them with me first, and you may be required to submit a safety proposal.

Assignments, Assessment and Grading

Assignments will consist of images or videos paired with written technical reports, and must be submitted digitally via D2L. Videos must also be posted to Vimeo. Typically there are one or two individual assignments, two more individual cloud photography assignments and three team project assignments. All students are expected to provide written reports and self-assessments with their images, but expectations for the level of science discussed vary with the student's standing. The required image and report formats are detailed in other documents which will be posted on the Flow Vis website.

Detailed grading of your work will not be done, although it will be checked for completeness and quality, and you will be expected to revise and resubmit your reports if requested. Instead, you will be motivated to achieve excellence by the actual meaning, context and quality of your work. Qualitative feedback will be provided publicly during class critique sessions, by your peers and the instructor. Your reports will be constructively critiqued by a teaching assistant. In addition, your work will be publicly archived on the high-visibility Flow Visualization site (just Google 'flow visualization'). Employers in years to come may view this work when they Google your name.

Your grade for this course will be largely determined by your meeting the stated expectations for turning in all work and participation in critiques, and to a lesser extent by attendance at guest lectures, completing surveys, returning borrowed equipment, etc. In rare cases, substandard work such as poorly executed images and reports that grievously fail spell and grammar checks have resulted in lowered course grades.

Prerequisites

There are no formal prerequisites, but engineering students are encouraged to have completed a course in fluid mechanics, and fine arts students are expected to have completed a basic photography or film course. This course counts as a technical elective towards engineering degrees in the College of Engineering and Applied Science, and may be petitioned as studio or production credit towards photography and video degrees in the College of Arts and Sciences or as an upper division science credit towards any A&S degree.

Contact Information

Instructor: Prof. Jean Hertzberg
Email: Hertzberg@colorado.edu
Office: ECME 220, 303-492-5092
Personal Webpage: http:JeanBizHertzberg.com
Office hours will be determined (with your help) during the second week of classes. In general, you can stop by for help anytime, but I can't guarantee I'll be free. If my door is shut, that is a definite 'not available'. I read my e-mail two or three times a day, and can give quick response to short questions that way.

Teaching Assistant : TBD

Course Website

www.colorado.edu/MCEN/flowvis, or just Google 'flow visualization' or 'flow vis'. Our site is #1 in much of the world! This site has all sorts of useful content, and is the permanent site where your work will be posted. The website is currently undergoing a major overhaul. If you are a WordPress expert willing to work on this let me know! However, assignments and critiques will be handled via the D2L site.

Textbooks

No textbooks are required for this course. Instead, students are expected to research background information online and in the archival technical literature (yes, you might have to go to the library!).

The following texts are recommended. All are available online from Amazon.com or other booksellers. I own most of these, and you can preview them in my office. Many are available in the Engineering and/or MathPhysics Libraries on campus. Additional texts are referenced on the course website. **Several cost less than a pizza, and will serve you well both this semester and in years to come**:

The Cloudspotter's Guide by Gavin Pretor-Pinney. Perigee/Penguin Publishers. 2006. ISBN 978-0-399-53345-7. $14. A non-mathematical but accurate description of cloud physics and identification. Readable and useful for engineers and art students alike. An official publication of the Cloud Appreciation Society. **HIGHLY recommended.**

Flow Visualization Techniques and Examples, 2nd Edition, A.J. Smits and T.T. Lim. Imperial College Press, London, 2000. ISBN 1-86094-193-1. Available from World Scientific Publishing, http://www.wspc.com/books/engineering/p167.html. $98, but it's an excellent reference text. **Highly recommended for graduate students in fluids**.

An Album of Fluid Motion by Milton Van Dyke. Parabolic Press, Stanford CA, 1982. ISBN 0-915760-02-9. Classic images in black and white. This is $17, and worth every penny.

A Gallery of Fluid Motion by M. Saminy, K.S. Breuer, L.G. Leal, P.H. Steen. Cambridge University Press, 2003. ISBN 0 521 53500 X. $35. This is a collection of winners of the flow vis competition at the annual APS meeting. One of this course's images won in 2003, and another in 2006.

Multimedia Fluid Mechanics CD by C.F. Homsey et al. Cambridge University Press, 2000. ISBN 0-521-78748-3 CD-ROM. $27. This has introductory fluids concepts, using non-mathematical descriptions, illustrated by flow visualization stills and movies.

Handbook of Flow Visualization, Wen-Jei Yang, 2nd edition. Taylor and Francis, NY, NY 2001. ISBN 1-56032-417-1.$246. Detailed information on a wide range of topics.

Schlieren and Shadowgraph Techniques by G.S. Settles. Springer Verlag, 2001. ISBN 3- 540-66155-7. An excellent reference for these techniques, with practical suggestions for both small and very large systems.

Flow Visualization, Wolfgang Merzkirch, 2nd edition. Academic Press, Orlando, FL, 1987. ISBN0-12-491351-2 ($118). Classic flow vis reference. Quite technical, not a lot of examples.

Cameras

Students are expected to provide their own imaging device (in lieu of a textbook). A digital camera of 10 Mpx or more is recommended. The camera should provide the option of **manual focusing** and some type of exposure control: shutter speed, aperture, ISO and preferably all

three. One of many examples is the Canon SC260 HS ($200). Photoshop is recommended for image processing, and is available for $210 for students from the UMC Bookstore. Gimp is also a fine open source photo editing program and is installed throughout the ITLL. For video editing any program you are comfortable with is OK; Windows Movie Maker, Camtasia (my favorite), Final Cut for Macs, or even iMovie. Windows Movie Maker is installed in the ITLL.

Publications

This course has attracted a great deal of interest from the fluid dynamics and engineering education and art/science communities. Student images from previous course offerings have been presented at conferences (garnering several awards), published in professional journals and on the web, with the instructors as co-authors and selected for traveling and permanent public display. **Thus, students will be asked to submit high resolution digital files of their work and release a non-exclusive copyright to the instructor.** No prints or hard copies will be required. Students who supply contact information will be kept informed of all future publications of their work. All images and reports produced for the course will be published on the course website. **Videos may only use music to which rights have been acquired.** A list of volunteer musicians will be provided if you'd like to collaborate with a musician on original music for your video. Acquiring rights to other music via stock libraries is easy and inexpensive. You will be expected to **provide documentation of your music rights**.

At the end of the semester, you will be offered the opportunity to donate proceeds from the sale of your work. The proceeds will be used to benefit this course. Please visit http://www.cafepress.com/FlowVis to see examples of how your work might be used.

Professionalism Expectations

A primary objective of the Mechanical Engineering Department is to prepare each of our students for careers in the engineering profession. As professionals, engineers must meet high standards of technical competence and ethical behavior. According to the Accreditation Board of Engineering and Technology (ABET) code of ethics, engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

1. Using their knowledge and skill for the enhancement of human welfare;
2. Being honest and impartial, and serving with fidelity the public, their employers and clients;
3. Striving to increase the competence and prestige of the engineering profession.

The Department of Mechanical Engineering (ME) believes that it is essential for each of you to learn the professional behavior that will prepare you for your career after college. Therefore, in each mechanical engineering course you will be required to practice the professional behavior that will be expected by your future employers. This syllabus clearly outlines the ME policy regarding academic integrity and academic climate. These policies will be upheld in each of your courses throughout the mechanical engineering curriculum. However, we also expect that this culture of professionalism will pervade all of your University of Colorado experiences.

Academic Integrity

You will be asked to complete individual homework assignments in this course. Though you may work in groups to discuss and solve problems, it is expected that you will abide by the University of Colorado at Boulder honor code at all times. Therefore, you may not plagiarize images or reports or allow another student to plagiarize your work. Examples of plagiarism include: copying from a solution manual, copying from Internet sites, copying from previous academic year homework sets, and copying directly from classmates. However, in your reports **for this course** you can (and should!) use direct quotes and paraphrased information from the Internet and other published sources ***as long as you properly cite the source.*** If you have any doubt about how to

cite, or whether you are using sanctioned materials, please ask. Citation techniques will be covered in lecture. Plagiarism detection will be enabled in D2L, and you will be able to check the overlap of your reports with others.

Any instances of dishonesty on homework or tests will result in a minimum sanction for your first violation of the honor code of a zero score and an entry in your department file. Additional sanctions will be imposed by the ME Department for subsequent violations, possibly including expulsion from the ME program. You may contest any accusation according to the campus honor code system.

University of Colorado at Boulder Honor Code Policy:

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at http://www.colorado.edu/policies/honor.html and at http://www.colorado.edu/academics/honorcode/

Mechanical Engineering Graduate Program Integrity Policy:

All students in the Mechanical Engineering Graduate Program are expected to uphold the Honor Code. The purpose of CU's Honor Code is to secure an environment in which academic integrity is valued and students and faculty act accordingly. The following principles are to be upheld: honesty, trust, fairness, respect, and responsibility. Below are excerpts from the policy. More information on the policy can be found at http://www.colorado.edu/mechanical/programs/graduate/current/index.html.

If a faculty member suspects a student of cheating, the faculty member is expected to document the event(s) in writing. Documentation should be submitted to the Graduate Committee within two weeks of the event. The Graduate Committee will review the event(s) and documentation and recommend an academic sanction to the faculty member. This review can include an interview with the faculty member and/or the student. The recommended academic sanction should be implemented within four weeks of the event. Minimum sanctions could include a zero score for homework or a zero score for an exam. If the faculty member invokes an academic sanction, the faculty member shall communicate the decision to the student in writing and include a brief summary of the faculty member's reasoning.

Any academic or non-academic sanction that has been applied to a student in the ME department must be documented in their department file. This includes sanctions and cases of cheating found in other programs and departments at the University of Colorado. The student's advisor will also be notified when such an event has occurred and has been documented in their file.

Academic Climate

In Class Expectations:

It is our expectation that each of you will be respectful to your fellow classmates and instructors at all times. In an effort to create a professional atmosphere within the classroom, it is requested that you:

- Arrive to class on time

- Turn off your cell phone
- Limit use of your laptop computer to class purposes
- Put away newspapers and magazines
- Refrain from having disruptive conversations during class
- Remain for the whole class, or if you must leave early do so without disrupting others
- Display professional courtesy and respect in all interactions related to this class

Compliance with these expectations will assist us with the creation of a learning community and a high quality educational experience. The University of Colorado Classroom behavior policy will compliment the outlined classroom expectations. The University of Colorado Classroom Behavior policy is stated below.

University of Colorado Classroom Behavior Policy:

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See polices at
http://www.colorado.edu/policies/classbehavior.html and at
http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

Discrimination and Harassment:

Discriminatory and harassing behavior will not be tolerated in the Department of Mechanical Engineering. A safe and inclusive environment will be created and maintained by the students and instructing faculty member. Students with concerns about discrimination or harassment actions should immediately contact the instructor, the Department Chair or their academic advisor, or contact the Office of Discrimination and Harassment (below).

Examples that may be considered harassment:

A teaching assistant or instructor asking a student for a date.
Displaying sexually explicit material in an academic setting (including laptop wallpaper).
Persisting in asking a classmate for a date after being turned down.
Using degrading terminology in referring to others, including peers.

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh

Out of Class Expectations:

Though many of the above stated policies address academic climate within the classroom, these policies should also be upheld outside of the classroom. As a member of the ME community you are expected to consistently demonstrate integrity and honor through your everyday actions. Furthermore, faculty and staff members are very willing to assist with your academic and personal needs. However, multiple professional obligations make it necessary for us to schedule our availability. Suggestions specific to interactions with faculty and staff include:

- Respect posted office hours. Plan your weekly schedule to align with scheduled office hours
- Avoid disrupting ongoing meetings within faculty and staff offices. Please wait until the meeting concludes before seeking assistance. Respect faculty and staff policies regarding use of email and note that staff and faculty are not expected to respond to email outside of business hours. Send emails to faculty and staff using a professional format. Tips for a professional email include:
    - Always fill in the subject line with a topic that indicates the reason for your email to your reader.
    - Respectfully address the individual to whom you are sending the email (e.g., Dear Professor Smith).
    - Avoid email, chat room or text message abbreviations.
    - Be brief and polite.
    - Add a signature block with appropriate contact information.
    - Reply to emails with the previously sent message. This will allow your reader to quickly recall the questions and previous conversation.

Accommodation of Disabilities or Religious Commitments

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.Colorado.EDU/disabilityservices

If you have a temporary medical condition or injury, see guidelines at http://www.colorado.edu/disabilityservices/go.cgi?select=temporary.html

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. *In this class, attendance is required for critique sessions and guest lectures, so please check the posted schedule, and let me know of any conflicts within the first two weeks of the semester.*

_____ SIGNATURE PAGE _____

I, the undersigned, agree that I have read and understood the policies described in the syllabus for MCEN 4151/5151/ FILM 4200/ ARTF 5200 Flow Visualization. I hereby agree to comply with these policies.

PRINT NAME_____

SIGNATURE_____

DATE_____

Initial Assignments
Flow Visualization: The Physics and Art of Fluid Flow
Fall 2015

Due Friday 8/28, start of class:

1. **Fluids Perception Survey:** You will receive an email invitation and link to the online survey. The software will know if you respond, but your responses will still be anonymous. This is part of a research project on the effectiveness of this course. Participation is voluntary, but is expected and much appreciated. You may opt out of the survey, but still get credit via a link in the email.
2. **Copyright Agreement Form** signed hardcopy due in class.
3. **Syllabus Agreement Form** signed hardcopy due in class.
4. **Flow Vis Background survey:** This survey will be used to place you on teams of mixed backgrounds, skills and equipment. Again, you will receive a link at your CU email address.

Due Monday 8/31, start of class

1. **Best of Web**. Due via a DISCUSSION in D2L. Look over course materials, and previous years' images and reports. Explore the links page too. but remember we are looking for a balance of aesthetics and science. You need to know what has been done in order to push the boundaries of new work. For this assignment, choose an online image or video that you feel exemplifies the best art/science flow visualization. Go ahead and check out Youtube, but **your submission must include attribution to the original authors of the image or video**. A link to something that has been reposted is NOT sufficient. If you can't find out who the original author is, you must choose a different work. You will be asked to vote on your classmates' choices (and they will vote on yours).

Due Friday September 4

2. **Vote** on 'Best of Web' in D2L.

Due Monday Sept 14 by *4 PM*:

3. **Image Assignment 1: Get Wet**.

The purpose of this assignment is to "get your feet wet". Make a picture of fluids (air or water, gas and/or liquid, any fluid, any combination of fluids) that both (1) demonstrates the phenomenon being observed and (2) is a good picture. Use any imaging technique you are familiar with, analog or digital, still or video, black and white or color, positive or negative, flash or available light, etc. Make the clearest, sharpest, cleanest, most interesting picture possible.

This means you will probably need to set up a situation, control your variables, do it once, observe the results and do it again once you know what works and what doesn't. **Keep notes** on what you've done for your write-up. You should expect to spend 20 hours on this assignment, including the write-up.

You are welcome to work in teams to create the image you want, but you are individually responsible for your own final image. Formal teams and more elaborate projects will be set up for later assignments.

Everyone's images will be displayed and critiqued in class beginning Wednesday Sept 16. ***You will be expected to bring your laptop and enter comments on everyone's images.*** Your

comments will be anonymous, signed only by your MEID number, which will be available in the D2L grade book.

All images must be accompanied by a short REPORT, due one week after your image is critiqued. If your image is critiqued on a Wednesday, your report is due at 4 pm the next Wednesday. See the Report Guidelines document on the website for info.

To speed posting your image on the website, please provide the following, in the D2L assignment drop box:

a) **Final image**: the best resolution file you have of your final image or clip, for future large format prints and presentations. TIFF, png or Photoshop formats preferred; jpg and raw formats are ok for unedited images. Use the best resolution setting that you can. If your camera only takes jpgs, use the largest file, finest jpg setting. **If you edit the file (and you should at least crop appropriately and set the contrast) DO NOT SAVE AS A JPG**. Save as TIFF, PNG or some other lossless format instead.
Final Video: Your video should include a title with your name as author. Post your video on Vimeo and submit the link in the D2L dropbox, along with the high-resolution copy of your video. If you use music (and it is recommended), you must provide documentation that you own permission to use it. Music students are standing by hoping to create music for your video; see posted list.

b) **Original**: Whatever your original (still) camera file is. Raw, CR2, NEF, jpg, whatever. If you are shooting video, unedited video clips are required if your video processing includes color shifts or distortions.

c) **Reports,** one week after your image is critiqued in class: Both a Word document of your report, and a pdf , both in the D2L dropbox designated for reports.

d) **SAF:** A completed image self-assessment form, also in the D2L report dropbox, on the same date that your report is turned in.

Image assignments are due 4 pm two days before critique begins, so I have time to put the slideshow together before class.

Please include your last name, assignment name and year as part of each file name. If D2L is a problem, you can use CU-Boulder Safe File Transfer (https://accellion.colorado.edu), share the files with me via Googledocs or Dropbox, email the files to hertzberg@colorado.edu or, as a last resort, drop off a CD or a USB memory key to ECME 220 (will be returned in class). **Submitting via D2L is much preferred**.

Hints for Get Wet:

- Using the built in flash on your camera usually results in ugly images. Use something like white cardboard, foil, or tissue to 1) bounce the light so it comes from a different direction and 2) diffuse the light to soften the shadows. A small light tent and a couple of lights are available for checkout in the Idea Forge.
- Avoid distracting backgrounds. Tabletop photo tents and seamless backdrops are available for checkout in the Durning lab.
- If you image a drinking glass or bottle, make sure no distracting text or logos are visible on the glass.

- If you use a fish tank or other glass enclosure, be careful about where the flash reflects off the glass (to become a distracting white hole in your photo).
- Automatic focus systems often have trouble with fluid images, which have no sharp lines. If your camera has a 'focus lock' feature (try pressing the shutter button halfway), lock on a ruler or other sharp-edged object held in the desired focus plane before you make the image, or use manual focus.
- Almost any deficiency in color balance, contrast, etc., can be adjusted in Photoshop, but this requires a working familiarity and access to the program. The Quickstart Photoshop book is the easiest entry point if you don't know the program. Some instruction will be given in class.

Safety considerations: If you want to work with **flames**, you must follow the combustion guidelines posted on the website. When working with household materials, you are pretty safe if you stick to personal hygiene (i.e. soaps and shampoos) and food products. If you are working with cleaning or medical products, or lab chemicals, you must discuss them with me first, and you may be required to submit a safety proposal.

Due Monday October 5, 4 pm.

4. **The Photography of Clouds.** There will be two Cloud assignments, with the first due **Monday Oct 5**, and the second image due November 16. This is to give plenty of opportunity to observe a variety of atmospheric conditions. ***Images made before August 24 2015 will not be acceptable for the Cloud First assignment, and images made before October 5 will not be acceptable for the Cloud Second assignment.*** Exceptional images made prior to this course cannot be submitted for credit in this course, but I encourage you to share them on the web. ***Be sure the date set in your camera is correct; it will be used to place your image on the website in chronological order.***

Cloud image submission should include

a) your edited image (video requirements are the same as for the GW assignment)
b) your original (unedited) image
c) the appropriate Skew-T diagram
d) a short statement of cloud type and whether the atmosphere was stable or unstable. Not a document, just a short note. You will be expected to discuss this in class during your critique.
e) One week after your image is critiqued in class you will submit a report, and an assessment form, same as for all the other images/vids. Your report should also include the appropriate Skew-T diagram. See the Report Guidelines document for additional details on the cloud report requirements.

Photograph a cloud. In fact, photograph clouds as often as possible, and start as soon as possible. You will soon discover that it is not easy to do but that it is a very pleasant diversion from everything else that you do.

Do keep track of where, when, and how the image was made, including what direction you were facing, and what was going on elsewhere in the sky. ***Your report must include atmospheric sounding data*** (e.g. a Skew-T diagram; we'll cover how to download the data in class from http://weather.uwyo.edu/upperair/sounding.html) and discuss the physics revealed. There will be a series of lectures on cloud physics to help you interpret your images. The most common problem is selecting the wrong date/time for the sounding data.

The morning data is taken with a 12Z time, with the correct date. Evening data will have a 00Z timestamp *for the next day*. The Report Guidelines document includes information for you cloud reports.

The most famous "cloud" photographs were made in black and white by the legendary early twentieth century New York art dealer, photographer, and husband of Georgia O'Keefe, Alfred Steiglitz. He called them "equivalents" and considered them to be music.

Sunrise and sunset are sometimes quite colorful or even extraordinary, but may be difficult to capture in a satisfying way. During the day, individual clouds can be extremely interesting. In the course of this assignment you will discover what the English writer and amateur photographer George Bernard Shaw once said about the photographer: "The photographer is like the cod (fish) who lays a million eggs so that one may hatch." So, keep looking up and keep pressing the button. And, if you have access to an extreme wide angle lens as well as a telephoto lens, use them as needed and as often as possible. Also consider making a short time lapse video instead of, or in addition to a single image. Some digital cameras have software to automate this process, and you can check out an automatic timer from Prof H. Quicktime Pro is an inexpensive program that can easily turn a sequence of image files into a video. Also try photographing clouds at night. Most cameras are sensitive enough to accomplish this now, depending on the phase of the moon, but a tripod will be needed.

Clouds require that you think outside the box.

Additional hints:

- No doubt you have seen the absolute black skies of Ansel Adams, with brilliant picturesque white clouds. This trick is accomplished using a red or orange filter with black and white settings. A circular polarizing filter can be used to heighten contrast in color images, but they are pricey and may cause color shifts. This can also be simulated in Photoshop afterwards, at least to some extent.
- Good cloud images can be acquired from airplanes. Be sure your window is clean, and sit in front of the wing if possible, on the side towards the sun.
- Again, many cameras have difficulty focusing on clouds. A manual setting for infinite focus distance is best. You might be able to do a focus lock on a distant hilltop.
- Avoid foreground objects like trees or buildings unless you specifically want them in the image. Parking lots and structures often have good sky views.