01 Course Intro

Thursday, December 30, 2010
3:30 PM

3 HANDOUTS

SYLLABUS
INITIAL ASSIGNMENTS
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Today:

- Syllabus
- Schedule
- First Assignments (7?!?!)

ITLL orientations: For after-hours access and computer login, attend a 1/2 hr tour. Find out what resources are here, agree to not spill drinks on the keyboards. M-Th 5:05 pm, in front of the ITLL office next door. Reservations recommended but not required.

syllabus

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SYLLABUS

MCEN 4151/5151/ FILM 4200/ ARTF 5200

Flow Visualization: The Physics and Art of Fluid Flow

Spring 2011

Course Overview
Role of this Course in the Mechanical Engineering Curriculum

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 be defined as an execution of a vision. 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 for the past 17 years 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

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[1]. http://www.aps.org/units/dfd/.

[2]. Samimy 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).

art students, the 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 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.

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")? If so, how can these 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 and/or art history, critique sessions, and occasional lab/studio sessions. Emphasis will be placed on the production of student images. A final showing will be produced (possibly in the Engineering Center Gallery or the Boulder Museum of Contemporary Art) 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 some effort to meet with their teams outside of class. Students are expected to attend all critique sessions, and bring their laptops to offer online, 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 techniques, and document their work in written reports. In addition, the evolution of photography from a scientific pursuit to an established art form will be studied. Questions such as "what makes an image scientific? What makes an image art?" will be explored.

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.

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. 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. Instead, you will be motivated to achieve excellence by the actual meaning and context and quality of your work. Qualitative feedback will be provided publically during class critique sessions, by your peers and the instructor. In addition, your work will be publically archived on the Flow Visualization site. 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.

Policy on Privacy of Graded Work

Federal law requires that your grades be communicated to you privately. You have been assigned a unique, private ME ID number for this purpose, and it will be the same for all your ME courses. Your ME ID number will be posted in CULearn, and you will be expected to sign your critiques with this number. The CULearn gradebook will document that you have met various expectations for work turned in etc.

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 a 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

Instructors: **Prof. Jean Hertzberg**

Email: Hertzberg@colorado.edu
Office: ECME 220, 303-492-5092
Personal Webpage: http://stripe.colorado.edu/~hertzber/

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 (mostly for CULearn issues):
Jesse Capecelatro: jessecaps@gmail.com

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. However, assignments and critiques will be handled via the CULearn site.

http://flowvis.colorado.edu

Textbooks:

No textbooks are required for this course. Instead, students are expected to research background information on the web and in the archival technical literature.

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**:

FlowVis

The Cloudspotter's Guide by Gavin Pretor-Pinney. Perigee/Penguin Publishers. 2006. ISBN 978-0-399-53345-7. $14. A non-mathematical but accurate physical 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, 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 $15, 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. $16. 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.

Fees

Currently there are no course fees. 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 (shutter speed, aperture or both) control. Photoshop is recommended for image processing, and is available for $210 for students from the UMC Bookstore. Photoshop is also installed on a handful of computers in the ITLL. Large format digital printing is available in the ITLL, but prints are not required. Student teams will have access to a range of fluid flow and photographic equipment in the ITLL, and selected research laboratories; see Flow Vis website for documentation.

RTFM

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 (scanning services will be provided for those working with film), and release a non-exclusive copyright to the instructors.** 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.

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 image or report 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 your current instructor/professor.

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 the campus honor code system.

The University of Colorado Honor Code policy is stated below.

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/

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 Discrimination and Harassment policy is stated below.

University of Colorado Classroom Behavior Policy:

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_____

schedule

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Schedule
1/7/2011
MCEN 4151/5151 FILM 4200/ARTF 5200
Flow Visualization: The Physics and Art of Fluid Flow
Spring 2011

Week	Monday	Weds	Friday
1	1/10 Intro, expectations. Get Wet, Clouds 1, Best of Web assigned.	1/12 Overview, survey of images **Fluids Perception Survey due(online)**	1/14 **Guest Lecture: Mark Winokur, "Other Aesthetics than Beauty"**
2	1/17 MLK day, no class	1/19 Overview continued **Background survey due (online) Copyright agreement due (hardcopy) Syllabus agreement due (hardcopy)**	1/21 Fundamentals of imaging: framing, camera types, lenses Bring your camera **Best of Web due.**
3	1/24 Intro to Photoshop. Bring your laptop if you have PS on it.	1/26 Overview continued	1/28 Lecture: Fund.Imaging-, lenses, aperture, depth of field, exposure, resolution. Bring your camera
4	1/31 **Get Wet Project image due;** critique **Bring laptop for all critiques; attendance required for all critiques**	2/2 Critique continued	2/4 Critique continued
5	2/7 Clouds 1 lecture **GW Report due 1 week after your image is presented**	2/9 Clouds 2 lecture Meet your team	2/11 Clouds lecture 3.
6	2/14 Teamwork Facilities descriptions	2/16 Equipment demos in the ITLL: flume, dye injection system, Hele Shaw cell, birefringence.	2/18 Equipment demos in the ITLL: Vortex ring generator, Soap film tunnel, ultrasonic aerosols, Hele Shaw cell. Durning: high-speed camera
7	2/21 **Clouds 1 due.** Critique. Laptop! **Email Team Project 1 plans.**	2/23 Clouds critique 2	2/25 Clouds critique 3
8	2/28 Flow physics I **Clouds 1 Report due**	3/2 Flow physics II	3/4 Flow Physics III

9	3/7 **Team Project 1 due**; critique	3/9 Team 1 critique continued	3/11 Team 1 critique continued
10	3/14 Time and space resolution , Dyes 1 or maybe guest lecture **Team Project 1 Report due 1 week after your image is presented.** **Hands-on setup due with report.** **Email Project 2 plans**	3/16 Dyes 2	3/18 Dyes 3
11	3/21 SPRING BREAK	SPRING BREAK	SPRING BREAK
12	3/28 **Team Project 2 due**; critique	3/30 Team 2 critique continued	4/1 Team 2 critique continued
13	4/4 Particle Seeded flows 1 **Team 2 Report due 1 week after your image is presented.**	4/6 Seeded flows 2 physics; bubbles and particles	4/8 Seeded flows 3 Particles and light
14	4/11 **Clouds 2 due; critique**	4/13 Clouds 2 critique continued	4/15 Clouds 2 critique continued
15	4/18 History of technologies enabling art. Guest Lecture: Mark Winokur **Clouds 2 Report due 1 week after your image is presented.**	4/20 Seeded flows 4 Particle generation techniques . Solid surface techniques: tufts, smears, TSP	4/22 Light bending: phase change, schlieren, shadowgraph
16	4/25 **Team 3 due;** critique	4/27 Team 3 critique continued	4/29 Critique and Class Show in Engineering Center Lobby, 3-5 pm. Refreshments. Last day of class.
Finals	5/2 **Team 3 Report due.** **Exit Fluids Perception Survey due.** **No final exam.**		

initialassign ments

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Initial Assignments
Flow Visualization: The Physics and Art of Fluid Flow
Spring 2011

1. **Fluids Perception Survey:** Due in two days, Weds 1/12, before class! http://www.surveymonkey.com/s/FluPer. This is part of a research project on the effectiveness of this course. You may opt out of the survey without penalty by emailing Jesse.Capecelatro@colorado.edu.
2. **Copyright Agreement Form** signed hardcopy due Weds 1/19 in class.
3. **Syllabus Agreement Form** signed hardcopy due Weds 1/19 in class.
4. **Entry Survey:** Due Weds 1/19 Flow Vis Background survey. This survey will be used to place you on teams of mixed backgrounds, skills and equipment. http://www.surveymonkey.com/s/FVBackground
5. **Best of Web**. Look over course materials, and previous years' images and reports. Explore the links page too. 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. You will be asked to vote on your classmates' choices (and they will vote on yours). Due Friday 1/21, via CULearn.

6. **Image Assignment 1: Get Wet**. Due Monday 2/1.

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 Monday 1/31. ***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 CULearn grade book.

All images must be accompanied by a short report, due one week after your image is critiqued. See Report Guidelines document for info.

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

a) The best resolution file you have of your final image or clip, for future large format prints and presentations. TIFF 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) do not save as a jpg**. Save as TIFF or some other lossless format instead.

b) A copy of the original file, pre-Photoshop.
c) Word document of your report.
d) A completed image self-assessment form, either electronic or hardcopy.

Assignments are due in CULearn at 9 AM of the specified day, so I have time to put the slideshow together before class.

Please include your last name as part of each file name. If CULearn is a problem, you can use CU-Boulder Safe File Transfer (https://accellion.colorado.edu) or 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 CULearn is much preferred.

Technical Notes:

- 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.
- 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 held in the desired focus plane before you make the image.
- 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.

7. **The Photography of Clouds.** There will be two Clouds Assignments, with the first due **Monday 2/21**, and the second image due later in the semester. This is to give plenty of opportunity to observe a variety of atmospheric conditions. Images made before January 10 2010 will not be acceptable for the first assignment, and images made before February 21 2009 will not be acceptable for the second assignment. Exceptional images made prior to this course can be submitted in addition to new images for discussion and posting, please document them as best you can. ***Be sure the date set in your camera is correct; it will be used to place your image on the website in chronological order.***

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. A report is still required. ***You must include atmospheric sounding data*** (see Flow Vis website for links) 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 local date. Evening data will have 00Z time *for the next day*.

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 picture 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. Quicktime Pro is an inexpensive program that can easily turn a sequence of image files into a video.

Clouds require that you think outside the box.

Technical Notes:

- 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.
- 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.
- Don't include any foreground objects like trees or buildings unless you specifically want them in the image.