

∞ ...Symmetry and Aesthetics in Contemporary Physics, 2016... ∞

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Class Hours: Fridays, from 1 PM to 3:55 PM
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∞ Assigned Texts ∞

(1) Course Reader, available from AS Note takers window, adjacent to the Multicultural Center

(2) Fearful Symmetry, by A. Zee (2007 edition), available from the UCSB bookstore, or Amazon on line

Note: These are fairly small and light-weight, so please bring them with you to class each week so you can refer to them during the discussions.

∞ General Expectations ∞

There are two types of assignments: weekly reading reflections and art projects.
You are expected to do BOTH.

(1) Reading Reflections (RRs): DUE EACH WEEK. For each article or book chapter that you read, you are to write a Reading Reflection (RR), which you are to turn in, either in hard copy in class, or via email before class. I don't want a summary of what the author wrote; rather, I am looking for *your* reaction to the work. In the list of reading assignments I have written an "RR prompt" for each reading to help you get started, but feel free to take off in whatever direction you are inspired to go.

(2) Arts-based assignments: In addition to the reading reflections, there will be 3 arts-based assignments plus a final physics-art project. These assignments are explained in detail below.

∞ Grading Policy ∞

CCS courses, even electives, have high expectations, and are "worth" 4 credit points. All CCS classes are pass/no pass, but 4 points is equivalent to an A, 3 points a B, etc, even though only "P" for pass will appear on your transcript. (If you are not in CCS and need a letter stating that you would have received an A, please contact me in the Spring Quarter and I will be happy to write one.)

∞ late work policy: I don't have one, and don't believe in them. I expect you to participate in all classes, assignments, discussions, field trips, etc., as honestly and authentically as you can. On the other hand, everyone is human, and sometimes *stuff* happens. Talk to me if you have a problem with any assignment, need more time, or have a family emergency or illness that will interfere with your participation. Feel free to call my cell, listed above.

∞ Arts-based Assignments ∞

1. Visualization of Einstein's Process of Physics

Einstein writes quite descriptively, with language that is grounded in his personal style of visualization and imagery. In fact, he is quoted as having said that images played a much more important role in his understanding of physics than words or equations. His writing is a bit dense, so you may have to go over passages several times, but once you get the flow of his language some clear images will hopefully emerge in your mind.

I have two objectives for this assignment:

1. That by drawing what Einstein is describing you will gain a deeper insight into the concepts *he* is trying to put across, which are more like the way physics is *really* done than what you may have been taught in lower school;
2. That by drawing the way you visualize Einstein's description, you will gain some insight into the way *your* mind works, and how your brain naturally processes information. It does not matter if you have no art training – just try to get down on paper some representation of what you see in your mind's eye.

Drawing prompt: What is the process of doing science (physics), according to Einstein? How do you visualize this process as described by Einstein? Your drawing should be a visual essay of your response to this article, so that you can explain to a general audience the process of doing science according to Einstein. Your work will not be evaluated on its technical merit! Your work will be evaluated according to these criteria: 1. Did you represent the process of doing physics, as described by Einstein, in your own way? 2. Can you explain how your drawing relates to Einstein's article?

Turn in: Your drawing, and a brief description of how the elements in your drawing illustrate Einstein's description of the process of doing physics. Please be prepared to share and discuss your drawing in class on the assigned day.

I want to emphasize: It does not matter if you are trained in art or not! No one cares. The purpose of this assignment is to get in touch with the way you visualize and conceptualize stuff.

2. Symmetry demonstration:

Symmetry in physics is operationally defined: A system (or object) is said to possess a certain type of symmetry if the following is true: When you make a change in the system (translation, rotation, reflection, or combinations thereof), OR if you make the same type of change in YOUR viewpoint, the system remains unchanged (invariant). Objects ("things" and "creatures" in the macroscopic world, particles in the subatomic quantum world) and spaces (geometries) are characterized by the sets of transformations (symmetry operations) that leave them unchanged.

Artistic Prompt: What familiar things do you see, hear, or otherwise notice, in your environment or in your imagination, and what symmetries do they have? Think of: axes of rotation, reflection planes, self-similarity, wall paper symmetry, temporal symmetry (as in music) or spatio-temporal symmetries as in dance or any periodic motion (such as

planets). Choose one manifestation of symmetry that is most interesting to you and create a representation that you will present in class. This does not have to be a drawing, but you are free to work in any medium you choose: drawing, painting, sculpture, music, dance, computer simulation, or something else.

Turn in:

1. Your symmetry demonstration, presented in class;
 2. A one-page write up in which you discuss the symmetry group your demonstration represents, the symmetry operations apparent in it, and any other information that would be interesting for your audience to know, such as why you chose it, how you created it, why you chose a particular medium or materials, and any symbolic meanings that you have chosen which you would like to explain.
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3. Artistic explorations of spacetime concepts:

We have discussed the symmetries underlying Special and General Relativity. Special Relativity is a theory of spacetime without gravity, and General Relativity is a theory of spacetime in which the curvature of spacetime due to the presence of mass and energy causes that which we call gravity.

Artistic prompt: Relativity theory calls upon us to imagine a four dimensional reality. *How can we honestly do this?* Choose a concept that you find most intriguing about relativity, such as: length contraction/time dilation as measured by observers in moving reference frames; lack of simultaneity for moving observers; deformation of space and time; time stretching in a gravitational field or accelerating rocket; or something else from the readings or class discussions. Choose a medium in which you wish to work – drawing, painting, computer graphics, music, dance, poetry, etc. , and create a representation of your chosen concept.

Turn in:

1. Your representation of relativity, in class;
 2. A write up of your representation that includes: (a) an explanation of the concept and a description of how your representation shows it; (b) what you want your audience to take away from the experience; and (c) how your experience of creating this representation deepened your own understanding of the concept.
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∞ Final Project: Physics Work of Art: Due June 3rd , the last class.

For the final project, you are to create a Physics Work of Art (or Work of Physics Art, however you choose to look at it), which must illustrate, demonstrate, or explore one or more of the concepts we studied during the quarter. You may use any medium you like, and you may start from one of your previous assignments and build on it, if you wish.

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Prompt: Now that you have learned something about the way your mind works by doing the previous artistic assignments, I want you to create a work of art that teaches something to an audience or viewing public. You may use any of the three previous projects as a starting point, or create something completely new.

Your work, which you turn in, must include the following elements:

1. Define and describe in words the concept you wish to explore.
2. Describe the aspect you wish to illustrate, demonstrate, or otherwise explore.
3. Describe the goal you have for your audience – what do you want your audience to take away from their experience of your work? How will their understanding, outlook, or lives, be changed by their experience of your work?
4. Describe the medium you will work in, and why this medium is well suited to your goal.
5. Present your work in class and to the public.

The final presentation will be held either in the CCS Art Gallery or in the public gallery in the UCSB Library – to be decided.

During the reception you are expected to stand by your work for the first hour, and explain your piece to the public. After that you are free to mingle. I will provide food and drinks. PLEASE INVITE YOUR FRIENDS AND FAMILY!

As always, I am available to consult with you on any of the assignments, either during office hours or by appointment.

Above all, *have fun with these projects!*