

**Paper Assignment #1: Research Topic. Due Monday March 2.**

- (a) Pick one of the following themes and develop it into a focused research topic appropriate for a 15-20 page essay. Please submit your research topic to the link in the Brightspace Assignments Folder in the form of a document that includes:
  - (i) A specific research question related to the theme that can be addressed in a 15-20 page essay. This question should be as focused as possible: it should not be broad or general.
  - (ii) An initial abstract that provides a brief (one paragraph) summary of how you intend to address your research question.
  - (iii) An initial list of sources that are relevant to the research question and that can serve as the basis for a bibliography for a 15-20 page essay. Please read the guidelines on writing a research paper that were discussed in class to make sure your sources are appropriate (they should not be Wikipedia entries, lecture notes, or webpages and/or online articles that have not undergone peer review, or that have not been approved by me).
- (b) Your research question, your initial abstract, and your initial list of sources don't have to be identical to those that appear in the first draft of your essay (due at a later date). It's ok for all three to be modified over the course of your research. But they should not be modified *too* much: In particular, you may tweak your research question a bit between now and your first draft, but it should remain more or less the same question (on the same theme).
- (c) If you'd like to develop a research question on a theme that does not appear below, please let me know in advance to make sure the theme is appropriate for the topics of our seminar.

Sample Themes:

The 2nd Law of Thermodynamics  
Maxwell's Demon  
Entropy in Thermodynamics  
Entropy in Statistical Mechanics  
Entropy in Classical Information Theory  
Entropy in Quantum Mechanics  
Black Hole Entropy  
The Black Hole Information Loss Paradox

Sample Research Questions:

1. Why did Maxwell think the 2nd Law of thermodynamics was statistical in nature?
2. Does Boltzmann's approach to statistical mechanics explain the 2nd Law of thermodynamics?

3. Can statistical mechanics and/or thermodynamics be given an information-theoretic foundation?
4. Under what conditions can we equate statistical mechanical entropy with thermodynamic entropy?
5. Can von Neumann entropy be interpreted as thermodynamic entropy?
6. Can entropy be associated with "disorder"? (If so, *which* entropy?)
7. Can entropy be associated with the flow of time? (If so, *which* entropy?)
8. Can black hole entropy be interpreted as thermodynamic entropy?
9. Can black hole entropy be interpreted as entanglement entropy?
10. In what sense is information lost during the process of black hole evaporation?