

Second Writing Assignment

PHY101 emergence in Nature 2011

Handed out November 14th, 2011, due on **Wednesday** November 30th, 2011, at the start of class.

Choose one of the following topics

[1] In 2002, Stephen Wolfram self-published a book called *A New Kind of Science* in which he proclaimed a new paradigm for understanding complex systems based on insights from the field of cellular automata. Describe the foundation of these ideas. Summarize the main claims of the book. Find and discuss some of the critical reaction (positive and/or negative) to the book. Do you find the broad thesis of the book to be believable? (The entire book is available online.)

[2] It has been more than 20 years since James Gleick's book *Chaos, Making a New Science* introduced the phrase *chaos theory* to the popular imagination. Discuss the critical reception of this book and how the idea came into, and was assimilated by, popular culture. Where do you think the idea rests today? Has it become overused or hackneyed? Has it been co-opted or distorted over the years? How is the phrase or the idea used now, outside of its direct scientific context?

[3] Artist Jackson Pollock famously created abstract expressionist paintings by dripping paint directly onto a horizontal canvas on the floor. Describe this provocative technique and some of the recent discussion of it in terms of the physics of flowing paint. Pollock's works are sometimes claimed to be fractal. Discuss the pros and cons of this controversial claim. Do you think we can learn anything about Pollock or Art in general by studying physics or fractal analysis?

[4] *Phyllotaxis* is the botanical term for the arrangement of the leaves on a plant, or petals on a flower. It is an example of a highly symmetric and beautiful pattern than can be generated by simple rules. Discuss some of the rules that have been discovered, and describe some of the recent physics-based ideas and physical experiments that have contributed to the understanding of phyllotaxis.

[5] Ever since Adam Smith's "invisible hand", economists have invoked various kinds of rational or optimizing collective behavior to explain markets or economic agents. Discuss the concept of emergence as it is used (or misused) in mainstream economic theory. How has the relatively new science of complex systems, with its emphasis on chaos, self-organization and nonlinearity, impacted traditional economic thinking? Or has it?

General Instructions (same as the first assignment)

You must hand in **both** a paper and an electronic copy of your paper. You should hand the paper copy in **at the start of class** on November 30th, and **e-mail** the electronic copy **to your seminar TA** the same day. Your paper is not handed in until both parts are in. TA e-mails are linked from the bottom of the course homepage. **Put your tutor's name on the paper copy.**

Late papers will be accepted up to one week after the due date. Ask your TA for the location of the late drop box. A mark penalty of 15% per day (including weekends) will be applied to late papers.

Your paper should be about 1500 words long, and certainly not more than 2000. This probably corresponds to about 5 or 6 pages. Your paper will be marked by your seminar TA.

We are interested in your *own* thoughts and ideas, not a rehash of someone else's opinions or ideas. We understand that you are not an expert at science. Presenting someone else's words as your own (including copying verbatim from web pages) constitutes **plagiarism**, and is a serious academic offense.

The simple solution is to properly **cite your sources**, including online sources. We will not be too fussy about the exact format of the citations, just that they be honest, complete and fair. Use whatever format you are most comfortable with. Your paper need not conform to the highest standards of formality; use a style that suits *you*.

See <http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize> for good advice on how to avoid plagiarism.

In physics, we usually use the Numbered Note citation system described on <http://www.writing.utoronto.ca/advice/using-sources/documentation?start=3>

For how to properly cite online sources, see <http://www.writing.utoronto.ca/advice/using-sources/documentation?start=4>

You should of course be careful to check that sources, especially online sources, are reliable and describe mainstream ideas. Many web pages about physics are written by cranks or people with their own personal agendas and theories of the universe. *Caveat Emptor*.