STEM Society Meeting, July 8, 2014

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1 About the STEM Society and the STEM Society Website

STEM is an abbreviation for Science, Technology, Engineering and Mathematics. The acronym STEM is commonly associated with K-12 education, but our use of the term is only slightly bound to this meaning. There are over one hundred people on the mailing list, although a much smaller group attends any one meeting. We meet on the second Tuesday of each month at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The meetings are open to all. The start time is 6PM. We make presentations, have discussions, and have demonstration experiments. These relate to Science, the History of Science, Mathematics, Engineering, Philosophy and Technology at all levels. The topics have ranged from a technical discussion of the mathematics of General Relativity to scientific experiments for young students.

These meeting notes contain links to many other documents, which may be viewed or downloaded by clicking the link. A partial list of documents can be reached by clicking the heading **Documents**. The meeting notes may also be viewed in an archive file which is in the list of documents. Most of the documents are PDF files. They may be viewed or downloaded to the computer by clicking, provided Adobe Reader is present, or another program capable of reading PDF files. There are many more documents available at the site than are listed under **Documents** because the documents.htm file is not at all up to date. The last time I checked, about March 2014, there were about 350 document files on the site.

The web site is:

`http://www.stem2.org/`

Direct to the documents list:

`http://www.stem2.org/je/documents.htm`

Direct to the archive file:

`http://www.stem2.org/je/archive.pdf`

2 The July Meeting Announcement

The July meeting of the STEM Society will take place on the second Tuesday of the month, July 8, 2014, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.
Possible topics are:

(1) We will consider the topic of Mathematical Economics and its relation to classical economics. This is a preparation for a talk that will be given by Larry Marsh next month (August meeting): **Indirect Exogenous Effects in Lagged Dependent Variable Models**. The Federal Reserve Bank buys and sells bonds in an attempt to control prices and the economy. We will attempt to shed some light on this activity.

(2) A while back we looked at a little problem involving spirals. Bob Williams gave me a little calculation on the helix at the last meeting. It is interesting to consider ways of calculating the self inductance of these and more complicated circuits.

There is a subject in mathematics called Knot Theory, which is part of Topology. So we can discuss what this subject is all about and its possible applications. So how can the self inductance of an arbitrary knot be computed? Knot Theory has been applied to the uncoiling of biological molecules such as DNA. Knot Theory is a notoriously difficult subject, so we shall just present a simple introduction.

(4) I attended last weeks Kansas City Maker Faire, and I shall talk a bit about what I saw there. Also I will also talk about changes to Kansas City's maker spaces.

(5) We shall likely have some book reports.

(6) Perhaps there will be some surprise projects and topics. You can contact me about any such topics, or just spring them upon us at the meeting.

The STEM Society Website:

`http://www.stem2.org/`

3 Cécele Lagandré: Pectinatella Magnifica, Strange Creatures Hauled Up From Lake Jacomo

See the Wikipedia article on Pectinatella_magnifica:

`en.wikipedia.org/wiki/Pectinatella_magnifica`

4 General Discussion

There was a wide ranging discussion of several topics, including the American history of the Polk administration, the Mexican war, and the reason that the Canadian Tar Sands are not in America.

5 Bob Kessler: Building Tour of the Kansas City Plant

Bob talked about the tour that will be given to Keven Truman of UMKC Engineering about reuse of a building at the plant. The plant has now been completely vacated. Tom Grant spoke about his experience of trying to get reuse of abandoned federal sites around the country, which he said are almost never successful.

6 The Helix, Its Self Inductance, and Bob Williams Calculation of Its Arclength

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There is a subject in mathematics called Knot Theory, which is part of Topology. So we discussed briefly this subject and its possible applications.

So how can the self inductance of an arbitrary knot be computed? Knot Theory has been applied to the uncoiling of biological molecules such as DNA. Knot Theory is a notoriously difficult subject, so we shall just present a simple introduction.

An approximate calculation of inductance of a helical coil is easy. An exact calculation was performed many years ago at the National Bureau of Standards (Now called NIST). This is available on the internet.

Snow Chester, **Formula For The Inductance Of A Helix Made With Wire Of Any Section**, National Bureau of Standards Scientific Papers. Scientific Papers of the Bureau of Standards, Volume 21, pp 431-518,

nbsscientificpaper537vol21p431_A2b.pdf (6.4 MB).

http://nvlpubs.nist.gov/nistpubs/ScientificPapers/nbsscientificpaper537vol21p431_A2b.pdf

This document is sixty some pages long. The technique used is to calculate a double integral of the vector potential and the current density vector in the wire. I have not checked this, but I would guess that the technique may appear in Jackson's graduate text **Classical Electrodynamics**

See the document **The Helix**.

http://www.stem2.org/je/helix.pdf

7 Knot Theory and the Self Inductance of a Knot

See the documents, **Knot Theory**, **Electromagnetic Theory**, and **Electrical Engineering**.

http://www.stem2.org/je/knots.pdf
http://www.stem2.org/je/electromagnetictheory.pdf
http://www.stem2.org/je/ee.pdf

See the Wikipedia article on **Knot Theory** for pictures and more information.

8 Economics and Mathematical Economics

I started a little introduction called **Notes on Economics**, which might make it obvious that I do not have great knowledge of this subject. But my notes do have some good references:

http://www.stem2.org/je/economics.pdf

Economics historically has been a rather fuzzy subject, so mathematical economics is an attempt to make economics more precise and well defined. Some economists question whether this has been successful. See the Wikipedia article on **Mathematical Economics**.

9 Least Squares Calculations and Regression

The least squares calculation is part of numerical approximation theory and functional analysis. It has a geometric interpretation as the orthogonal L^2 projection into a subspace. On the other hand the related regression theory is a subject of mathematical statistics, where the data are considered as samples of a probability distribution, with a functional dependence between two or more random variable, say X and Y. See the following documents, **Least Squares Approximation**, **Regression**, and **Probability Theory** which contain references.

http://www.stem2.org/je/lsq.pdf
http://www.stem2.org/je/regression.pdf
http://www.stem2.org/je/probabilitytheory.pdf

10 The Maker Faire and Changes to Kansas City Maker Groups

It was interesting that the KC Faire was bigger than ever. I had thought that this maker fad was dying. Steve Siegel did not have an exhibit this

year for the UMKC Physics Department, but was assisting Austin Feathers, who is a young guy who has been making Tesla coils since he was about 12. He is probably about 20 now I would guess. He has constructed a large Tesla coil that generates sparks about 15 feet long. And has a small Faraday cage were he aims the sparks, with the invited cage members surviving the onslaught.This is an imitation of the somewhat larger Tesla exhibit and show, called Arc Attack, that tours the country, which has been a featured show at KC Maker Faire for the past three years, and which cost the KC Maker Faire quite a bit of money. Austin is doing it for free this year, replacing Arc Attack.

There was much of interest at the Faire. It is now a little too large to see everything.

I talked to Dale Dougherty, the founder of these Maker Faires and Make Magazine, who is based in San Francisco. The Bay Area Faire is gigantic, with hundreds of thousands of attendees. Dale, with Tim O'Reilly, founded O'Reilly publishing company which is a major publisher of technical, scientific and Computer books.

Kansas City Maker groups are in a decline. Make:KC has been discontinued. They used to meet at the HMS Beagle store in Parkville.

The Metropolitan Community College Technical Center in the East Bottoms, had a FabLab for a while, but this no longer exists. The FabLab is an MIT invention.

The CCCKC (Cowtown Computer Congress Kansas City) Hacker and Maker group, which used to meet in the cave at 31st st., west of Southwest Trafficway (entrance at about 31st and Mercier), had moved to the Hammer Space on 63rd St near Oak (440 E 63rd KC MO), but has now left as a smaller group. They now have a space at DeVry University on Holmes Road in KC MO. They have an open house each Tuesday at 7PM in room 115.

The Hammer Space continues to exist and has an open house on Thursdays at 7PM.

There is a maker lab at the Central Branch of the Johnson County Library on 87th Street. They have a 3d printer, a Raspberry Pi, Mac Computers, various Software, photo and video equipment, and a green screen, all of which can be used for free.