

STEM Society Meeting, December 10, 2013

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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 usually more documents available at the site than are listed under "Documents" because the documents.htm file is not necessarily kept up to date.

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 December Meeting Announcement

The December meeting of the STEM Society will take place on the second Tuesday of the month, December 10, 2013, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.

A List of Possible Topics are:

- (1) Electronic equipment and experiments.
- (2) Science and Mathematics books and book reports.
- (3) Physics and Mathematics. I might try to do something simple in these areas, because in the past few meetings perhaps I have gone a little too deep.

(4) I have not followed closely the passage of the comet ISON. Perhaps someone could report on it and the Oort cloud, and comets and asteroids in general.

(5) Perhaps Bob Kessler would like to lead a discussion on Synthetic Biology, or other topics in Biology, such as the problem of remembering about whether one has eaten lunch today.

(6) As always, we expect there may be impromptu topics, projects, shows-and-tells, new theorems, experiments, book reports, problems and solutions in mathematics, physics, engineering, biology, scientific biographies, and such.

The STEM Society Website:

<http://www.stem2.org/>

3 Electronic Equipment

Oscilloscope BK Precision 1403A.

Audio Generator ECOL Model 377

AutoTransformer

Classic Electric Drill with universal motor AC/DC.

Brick Power Supply

Potentiometer

Diode

Rechargeable Electric Drill trigger speed control.

Switching Power Supply

Laboratory Power Supply

4 Books

- [1] Venter J Craig, **Life at the Speed of light**, 2013, Viking
- [2] Venter J Craig, **A Life Decoded, My Genome: My Life**, 2007, Viking.
- [3] Judson Horace Freeland, **The Eighth Day of Creation**, 1979, Simon and Schuster, reprinted 1996 with an afterword by Judson. (A classic early history of Molecular Biology)
- [4] Schrödinger Erwin, **What is Life?**, Cambridge University Press, 1944.
- [5] Fant Kenne, **Alfred Nobel: A Biography**, (translated from the Swedish by Marianne Ruuth), 1991, Arcade.
- [6] Massie Robert K, **Peter the Great: His Life and World**, 1980, Alfred A. Knopf.
- [7] Davis Helen Miles (Editor), **Scientific Instruments You Can Make**, Science Service Washington, (Science Talent Search), 1954. (On the last page is a picture of a Peaucellier Straight Line Mechanism constructed by the famous mathematician Paul J Cohen when a high school student at Stuyvesant High School in New York City, winner 1950.)

5 What is a Proof?

Students when required to prove something in Mathematics are sometimes puzzled. They might want to know exactly what are the steps needed. Students often learn in elementary school that one completes a school task by following a recipe. But a proof is a creative act, not a completely defined path to follow. Above all, you must convince yourself that the conclusion to be proved is absolutely certain. That is, a proof is a sequence of steps, each step being absolutely true, as you understand truth (our understand-

ing may become more sophisticated with time). If these steps then lead to the absolutely true conclusion, then the proposition has been proved to your honest satisfaction. The steps are up to you.

Of course someone might question your assertion that a given step is true and attempt to refute you. Almost always in mathematics when a step is in contention, the contending parties will reach a common conclusion that the step is either valid or invalid. To do mathematics one must be a truth seeker. If you don't care about truth, then you can not do mathematics. In the following subsection read the famous proof that the square root of a prime number is irrational.

Note. To say, "I don't understand," may not be a confession of ignorance, but rather a sign of mathematical brilliance.

5.1 A Crises in Greek Mathematics: What is a real number?

For the Greeks numbers were lengths of line segments. Fractions (rational numbers) are obtained by dividing line segments into equal pieces. They discovered that the diagonal of a square can not be equal to any multiple of a fractional division of the unit length of a square. This is a big problem for their concept of number!

Show that the square root of a prime number is not rational. So suppose the integer p is a prime, having no factors. Suppose \sqrt{p} could be written as a rational number, as a fraction say n/m , where m and n have no common factor, since if not we could divide out the common factors.

$$\sqrt{p} = \frac{m}{n}.$$

Squaring we have

$$p = \frac{m^2}{n^2}.$$

Then

$$n^2 p = m^2.$$

Hence p must be a factor of m , say

$$m = pr.$$

Then

$$n^2p = p^2r^2$$

But this implies that p is a factor of n . This contradicts our assumption that m and n had no common factor. Therefore the square root of a prime is not a rational number.