

STEM Society Meeting, January 14, 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 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 January Meeting Announcement

The January meeting of the STEM Society will take place on the second Tuesday of the month, January 14, 2014, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.

A List of Possible Topics are:

- (1) Demonstration experiments in Physics.
- (2) A Return to Relativity.
- (3) A review of topics in Calculus: What is e ?. What are Irrational, Algebraic, and Transcendental Numbers?
- (4) A review of Vienna Sausages, and the State of Austrian Engineering.
- (5) Electronics: How do we build a function generator?
- (6) Book reviews and discussions.
- (7) Recent news in biology.
- (8) 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 Demonstration Experiments in Physics

Julien Clinton Sprott (pronounced sprahht), Professor of Physics at the University of Wisconsin, has given physics demonstrations at Wisconsin, each year for 30 years, called "The Wonders of Physics."

He has written a book that is available at Linda Hall Library:

Clint Sprott, *Physics Demonstrations*, University of Wisconsin Press

The book contains videos, on two DVDs.

There is a list of videos available at Sprott's website, under the title, **Wonders of Physics**. The earlier videos are better than the later ones.

sprott.physics.wisc.edu/sprott.htm

4 Book Reviews

[1] Sprott Julien Clinton, **Physics Demonstrations**, U. Of Wisconsin Press, 2006.

[2] Maor Eli, **e: The Story of a Number**, 1994, Princeton University Press.

[3] Mintner Adam, **Junkyard Planet**, 2013.

Summary "When you drop your Diet Coke can or yesterday's newspaper in the recycling bin, where does it go? Probably halfway around the world, to people and places that clean up what you don't want and turn it into something you can't wait to buy. In *Junkyard Planet*, Adam Minter—veteran journalist and son of an American junkyard owner—travels deeply into a vast, often hidden, multibillion-dollar industry that's transforming our economy and environment. Minter takes us from back-alley Chinese computer recycling operations to recycling factories capable of processing a jumbo jet's worth of trash every day. Along the way, we meet an international cast of characters who have figured out how to squeeze Silicon Valley-scale fortunes from what we all throw away. *Junkyard Planet* reveals how "going green" usually means making money—and why that's often the most sustainable choice, even when the recycling methods aren't pretty. With unmatched access to and insight on the waste industry, and the explanatory gifts and an eye for detail worthy of a John McPhee or William Langewiesche, Minter traces the export of America's garbage and the massive profits that China and other rising nations earn from it. What emerges is an engaging, colorful, and sometimes troubling tale of how the way we consume and discard stuff brings home the ascent of a developing world that recognizes value where Americans don't. *Junkyard Planet* reveals that Americans might need to learn a smarter way to take out the trash"—Dust jacket flap.

[4] David Hames and Nigel Hooper, **Biochemistry**, 3rd edition, ISBN 0-4153-6778-6. The book contains several biology experiments that we may perform.

[5] Roach Mary, **Bonk**, Mary Roach has written several books on outrageous subjects, which are both very informative, and very amusing.

5 Vienna, Austria

A discussion of The Blue Danube, Mozart, Haydn, Einstein, pastry, Engineering and more, and Prague as a bonus.

6 Building Function Generators

Emery, **Low Cost Function Generators**,

<http://www.stem2.org/je/functiongenerator.pdf>

7 The Number e , Irrational and Transcendental Numbers

See the section about e in the document called **Quick Calculus**:

<http://www.stem2.org/je/calcq.pdf>

8 Relativity

Differential Geometry

<http://stem2.org/je/diffgeom.pdf>

Relativity Presentation, Power Point Slides as pdf file:

<http://stem2.org/je/relativity.pdf>

Relativity Document:

<http://stem2.org/je/relativ.pdf>

Schutz Bernard F.

A First Course in General Relativity
QC173.6 .s38, Linda Hall.

Carroll Sean M
Spacetime and geometry: An introduction to General Relativity,
(QC173.6 .C373 2004) Linda Hall.

9 Microbiology Experiment, Kent Smith

10 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 understanding 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.

10.1 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

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

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.