Uncertainty

Things you should learn:

1. Distinguishing between deterministic, mostly deterministic, mostly random variables/events
2. Why we treat some deterministic events as random
3. What's the difference between continuous and discrete random event
4. The concept of "independence" and why it's important
5. How random events are characterized—the concept of a distribution
6. Properties of distributions and distribution functions
7. The concept of sample space in probabilistic events
8. How probabilistic events relate to distributions
9. How moments characterize distribution functions
10. What are the statistics: mean, variance, standard deviation, skewness, kurtosis
11. How do they relate to the distribution
12. What sort of distribution do we obtain when we add together samples of a large sum of random events—the Central Limit Theorem
13. Why do many distributions look bell-shaped
14. With respect to measurements, what is a "standard error"
15. Why is the Normal or Gaussian distribution so important
16. What do you need to know to specify a particular Gaussian distribution
17. Finding "normalized" distributions
18. How to estimate a population statistic from taking a sample, e.g., the mean
19. How to estimate how good that estimate is
20. What one can do to improve that sample estimate
21. How to estimate errors in a problem that requires a sequence of error-prone measurements
22. The concept of expected value

Things you should be able do:

1. Calculate the mean, standard deviation, and variance of a set of data
2. Produce a frequency distribution plot with a graphical indicator of its mean and standard deviation
3. Calculate how many samples would be required to predict the population mean with a given standard error
4. Conceive of an experiment/measurement which will produce a Gaussian distribution
5. Calculate the maximum error in a problem which consists of a number of individual error-ridden measurements.

Things you should like awake thinking about:

1. What's the return (expected value) of the lottery
2. How do blackjack players improve their odds by counting cards
3. How does probability/uncertainty play a role in the design and siting of structures
4. How does designing for "zero defects" affect cost