History of Mathematics #1

1. Before Thursday, January 12
   (a) Be sure you can login to the moodle website, moodle.math.wvu.edu, and view the History of Math course site. Bookmark this site and explore it.
   (b) Be sure your computer is still Centra ready.
   (c) Install the software for the PC Notetaker and try it out.
   (d) Read The History of Mathematics in a Large Nutshell in *Mathematics Through the Ages* (MTA).

2. Thursday, January 12, 7 pm. Attend the Centra session for an orientation to the course, the moodle website, and the PC Notetaker.

3. Before Tuesday, January 17
   (a) Go to the Forum "Demonstrative Mathematics" and make at least three substantive contributions and at least two substantive responses to others' postings. How/when do we move to "demonstrative mathematics" in the K-12 curriculum? In geometry? In algebra? To what extent does this parallel the historical development of mathematics or not? Provide concrete examples.
   (b) Read Dunham Chapter 1, MTA Sketches 1–6, and Boyer Chapters 1–5. As you read, think about the following questions:
      i. To what extent is the historical development of mathematics reflected in the order and manner in which topics are introduced and developed in the K–16 curriculum?
      ii. How does Euclid prove that the sum of the measures of the angles in any triangle is 180 degrees? (See the website aleph0.clarku.edu/~djoyce/java/elements/elements.html).
      iii. What is a fraction? See page 53 of Boyer. How are they treated by Egyptians? By Euclid? Where are fractions treated as single numbers, and where as ratios of pairs of integers?
      iv. Try to carry out the quadrature of a rectangle (page 13 of Dunham) with Wingeom.
      v. Can two irrational numbers be commensurable?
      vi. Look up some other pretty geometric dissections. See, for example, www.ics.uci.edu/~eppstein/junkyard/dissect.html.

vii. Look up how to construct a regular pentagon with straightedge and compass.

viii. What are the constructible numbers? How can we use compass and straightedge constructions to add, multiply, invert, and take the square roots of constructible numbers?

ix. What implications does the Sketch 5 of MTA have for classroom pedagogy?

x. Boyer on page 4 states, "From the mathematical point of view it is somewhat inconvenient that Cro-Magnon man and his descendants did not have either four or six fingers on a hand." What does he mean by this?

xi. Explain the difference between the notion of "ordinal" and "cardinal"—see page 5 of Boyer.

xii. Explain the method of false position, Boyer pages 15–16, using modern notation. Should we teach this in the classroom?

xiii. Can you clarify Boyer's explanation of square roots and Newton's method on page 28?

xiv. See Boyer's statement on page 48 about "communal knowledge." Is any particular mathematical knowledge or other human knowledge communal in any aspect of the contemporary world?

xv. Can you prove the statement in Boyer on page 50 about the appearance of the golden ratio in the pentagram?

xvi. Read about musical ratios on page 55 of Boyer. What is "well-tempering" in the tuning of modern pianos?

xvii. Verify the algebra resulting in the cube root of 12 on page 71 of Boyer.

xviii. Note that in the diagram at the bottom of page 75 of Boyer, the C's should be shifted to the right.

xix. Read about geometric algebra starting on page 77 of Boyer. Find other examples.

xx. What are the six major problems on page 81 of Boyer? Do you agree with their significance?

4. Tuesday, January 17, 7–9 pm. Attend the Centra session to discuss the readings, forum, and comments and questions on the assigned homework due on Friday.

5. Homework problems due Friday, January 20, 11 pm, submitted to the email address mathhist@ms.uky.edu.

   (a) Derive the formula for the volume of a frustum given on page 4 of Dunham.

(b) Provide a description of two proofs that $\sqrt{2}$ is irrational (see page 10 of Dunham).

(c) In the discussion beginning on page 3 of Dunham we learn that every polygon can be subdivided into a finite number of pieces and reassembled into a square of the same area. Hence, given any two polygons P and Q of the same area, P can be subdivided and reassembled into Q (we say that P and Q are *equidissectable*.

  i. Give examples in K–12 curriculum in which this concept is used to derive formulas for areas of certain shapes.

  ii. Look up Dehn's theorem and given an example of two three-dimensional polyhedra having the same volumes that are not equidissectable (you do not have to present the proof).

(d) Consider the following sets: nonnegative integers (whole numbers), integers, rational numbers, constructible numbers, algebraic numbers, irrational numbers, transcendental numbers, real numbers, complex numbers.

  i. Extend the Venn diagram on page 23 of Dunham to include these sets.

  ii. Which of these systems are closed under addition? Which have an additive identity? Which have additive inverses? Which are closed under multiplication? Which have a multiplicative identity? Which have multiplicative inverses for the nonzero elements? Approximately when is each introduced in the K-16 curriculum?

6. Begin signing up for project presentation topics (a list of suggested topics is in preparation. Besides the presentation during the Centra session you will be asked for a written component).