AST1002

# Key Concepts for Astronomy

Chapter 3
The Science of Astronomy



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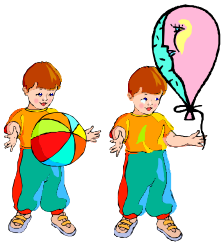
## Everyday Science

- Observation
- Trial and error
- Sharing discoveries
- Learning from Others





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## Everyday Science

- Observation
- Trial and error
- Sharing discoveries
- Learning from Others



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## Ancient Observations

- Observations of the Heavens may have stimulated the development of science and religion
- The Heavens provided much practical information for day-to-day life
  - Weeks, Months
  - Harvest moon
  - "Red sky in the morning …"



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## Ancient Observations

- Time of Day & Night

Sun Dial

- Dr. O's LELO experiment



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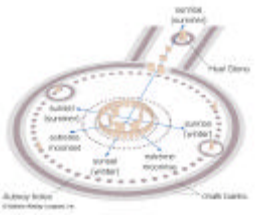
## Ancient Observations

- Time of Year
  - Sunrise / set; Moonrise / set



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## Ancient Observations

- Many other examples to be found in Archaeoastronomy
  - Alignment of temples in Mexico, Central, and South America to the sun, planets, and stars

  - "Sun Dagger" in Chaco Canyon, NM
  - Medicine Wheel in Wyoming

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## Ancient Observations

- Lunar Cycles
  - Interval between New Moons is about 29 ½ days
    - 12 lunar months is 354 or 355 days so lunar calendars shift about 11 days each year … this is the Islamic calendar
    - Metonic cycle: fit 235 lunar months into 19 years (12 years with 12 months, 7 years with 13 months) … this is the Jewish calendar

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## From Observation to Science

- Record keeping, analysis, prediction
  - Chinese records of comets, "guest stars", earthquakes, weather (state secrets?)
  - Mayan observations of Venus … detailed records, precise predictions, sophisticated mathematics (earliest use of "zero" known)

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## The Modern Linage

- 2700 – 2100 B.C. Egyptian Pyramids, ink based writing on papyrus
- 300 B.C. Great Library of Alexandria founded; center of scholarship for 700 years
- 415 A.D. Death of Hypatia, final destruction of the library

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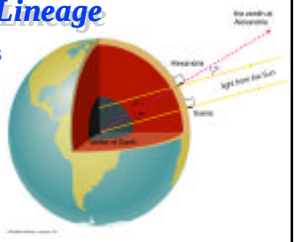
## The Modern Lineage

- Eratosthenes Measures the Earth (240 B.C.)
  - Two cities at same longitude, same time, 833 km apart



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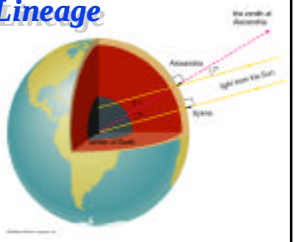
## The Modern Lineage

- Eratosthenes Measures the Earth (240 B.C.)
  - Two cities at same longitude, same time, 833 km apart
  - 7° = 7 / 360 of a circle
  - So 833 km = 7 / 360 of circumference **c**



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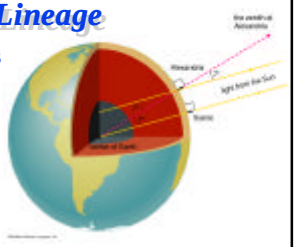
## The Modern Lineage

- Eratosthenes Measures the Earth (240 B.C.)
  - Two cities at same longitude, same time, 833 km apart
  - 7° = 7/360 of a circle
  - So 833 km = 7/360 of circumference **c**
  - Thus **c** = 42,000 km
  - In todays units, **c** = 40,000 km



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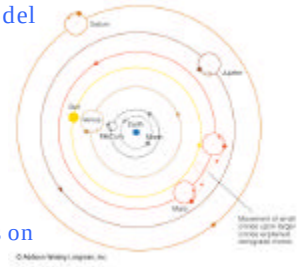
## The Modern Linage

- The Ptolemaic Model (c. 100-170 A.D.)
  - Based on earlier work going back to Plato
  - Earth centered (geocentric)
  - Off-center circles on circles



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## Oliver's Orrery

- CRTL Tab to Orrery here

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## A Long Interregnum

- From Ptolemy (150 AD) to Copernicus (1500 AD), little or nothing was contributed by "Europeans"
- The work of the Greeks as retained and re-introduced to Europe by Arabic scholars
- Literature, Art, Science flourished during this period in the Middle East

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## A Long Interregnum

- Many new concepts, especially in the area of "reduction to practice" were introduced in the Islamic world.
  - Navigation
  - Astronomical Instruments
  - "Arabic" numerals and "zero" (originally from India)
  - Algebra
- Contacts with Hindu and Chinese scholars

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## A Long Interregnum

- During the same period, Astronomy flourished in China
  - "Professional" astronomers
  - Precise Calendars
  - Concept of an "infinite" Universe filled with stars
  - Record keeping of observations of comets and "guest stars"
  - Instruments for measuring time etc.

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## Modern Science

- Idealized Scientific Method
  - Observation – collect data
  - Hypothesis – build a *Model* capable of predictions which can be tested
  - Experiment or further Observation - test predictions, refine or reject model
  - Theory –requires that the model is verified over a wide range of circumstances and many tests



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## Modern Science

- Actual Scientific Method
  - Individual scientists are human, have human biases
  - We come close to the ideal over time and many scientists
  - Publication, peer review essential
  - A paradigm (pattern of thinking) shift may take time



**Questions and/or Comments?**

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**or visit http://www.astro.ufl.edu/~oliver/**