

# Elmhurst College

## FYS-100.09 - Becoming a Skeptical Student: Science, Pseudoscience, and Self-deception

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### Development of Cosmology

Observations	Ideas
Stars move together Circular motion during night Fixed North star - axis	All stars attached to giant “crystalline” sphere Earth at the center Uniform rotation of sphere ⇒ <b>ALL move together in circles about earth</b>
A few wanderers (5 “planets” + sun & moon)	7 more spheres Different uniform rate for each new sphere ⇒ <b>UNIFORM rate for each planet</b>
Planets loop back and then catch up (“retrograde motion”)	Several nested spheres with tilted axes for each planet ⇒ <b>each planet at CONSTANT distance from earth</b>
Planets are brighter during retrograde motion	Large circle centered on earth (deferent) Smaller circle with center on large one (epicycle) Epicycle moves uniformly around deferent. Planet moves uniformly around epicycle. Lock motions of planets together ⇒ <b>Intrinsic (“natural”) explanation of brightness</b> ⇒ <b>Calculations of positions</b>
Position calculations don’t match measurements	Put epicycles on epicycles (80) Displace center of deferent Uniform motion about yet another point (equant) ⇒ <b>Detailed position calculations ...</b> [Arbitrary size, lots of parameters to be “tuned,” different versions emerge]
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	<p>Try the <b>SUN</b> at the center.          Early Greek speculation along this line</p>
	<p>Stars on BIG sphere centered on SUN          6 circles centered on SUN (5 planets + earth)          1 circle centered on earth (moon)          Uniform motion around SUN.          Earth rotates about North-South axis once a day.          ⇒ <b>Stars appear to move together in circles</b>          ⇒ <b>Planets appear to wander</b>          ⇒ <b>Apparent retrograde motion</b>          ⇒ <b>Intrinsic (“natural”) regularities for retrograde</b>          ⇒ <b>Calculations NEARLY match measurements</b>          (“Approximately Simple”)</p>
	<p>Add a few displaced centers and small epicycles          ⇒ <b>Calculations match measurements</b></p>

**Earth-centered and sun-centered theories BOTH match data (observations, measurements ...).**

**So what is needed? What should be done?**