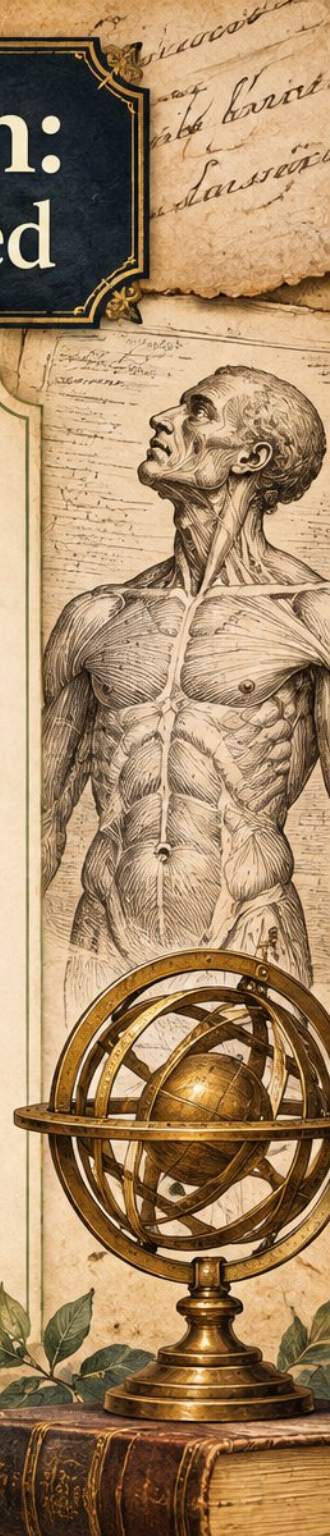
The Scientific Revolution:
How Ideas About Nature Changed



- Guiding question: what changed in how Europeans understood and investigated nature, c. 1500–1700?
- Three shifts: authority to evidence, purpose to mechanism, solitary speculation to organized inquiry
- For history learners, students, science teachers, and museum educators
- How to use this deck: chronology, case studies, sources, classroom and exhibition activities
- Framing caution: change was uneven and protracted, not a single sudden break



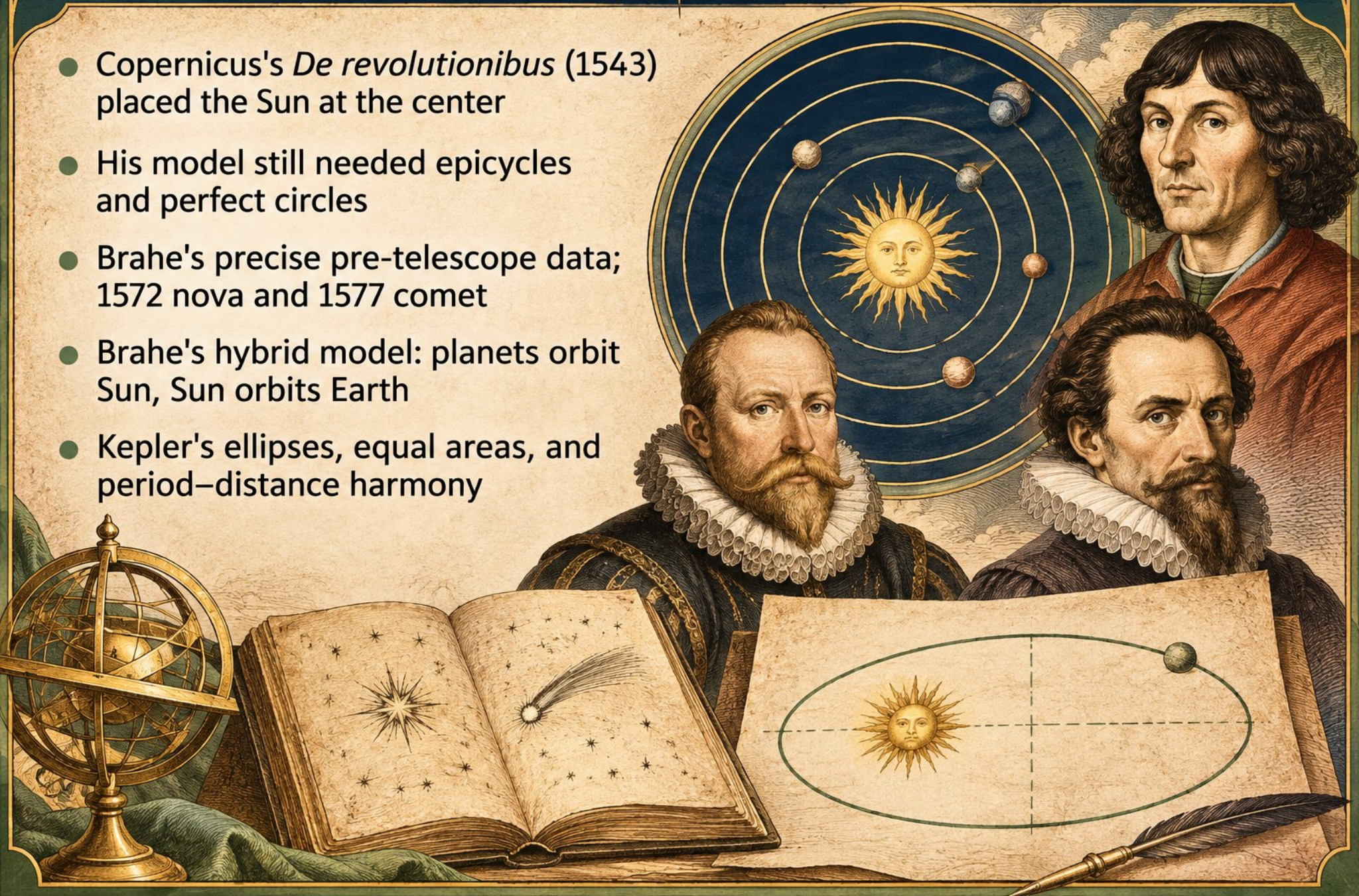
Before the Revolution: Knowledge of Nature Around 1500



- Aristotle's natural philosophy shaped university teaching: four elements, purposeful explanations
- Earth-centered astronomy carried deep cultural authority
- Galenic humoral medicine explained bodies, diet, and temperament as one system
- Knowledge-making lived in universities, courts, monasteries, and craft workshops
- These frameworks were coherent and useful in their own terms, not simply 'wrong'

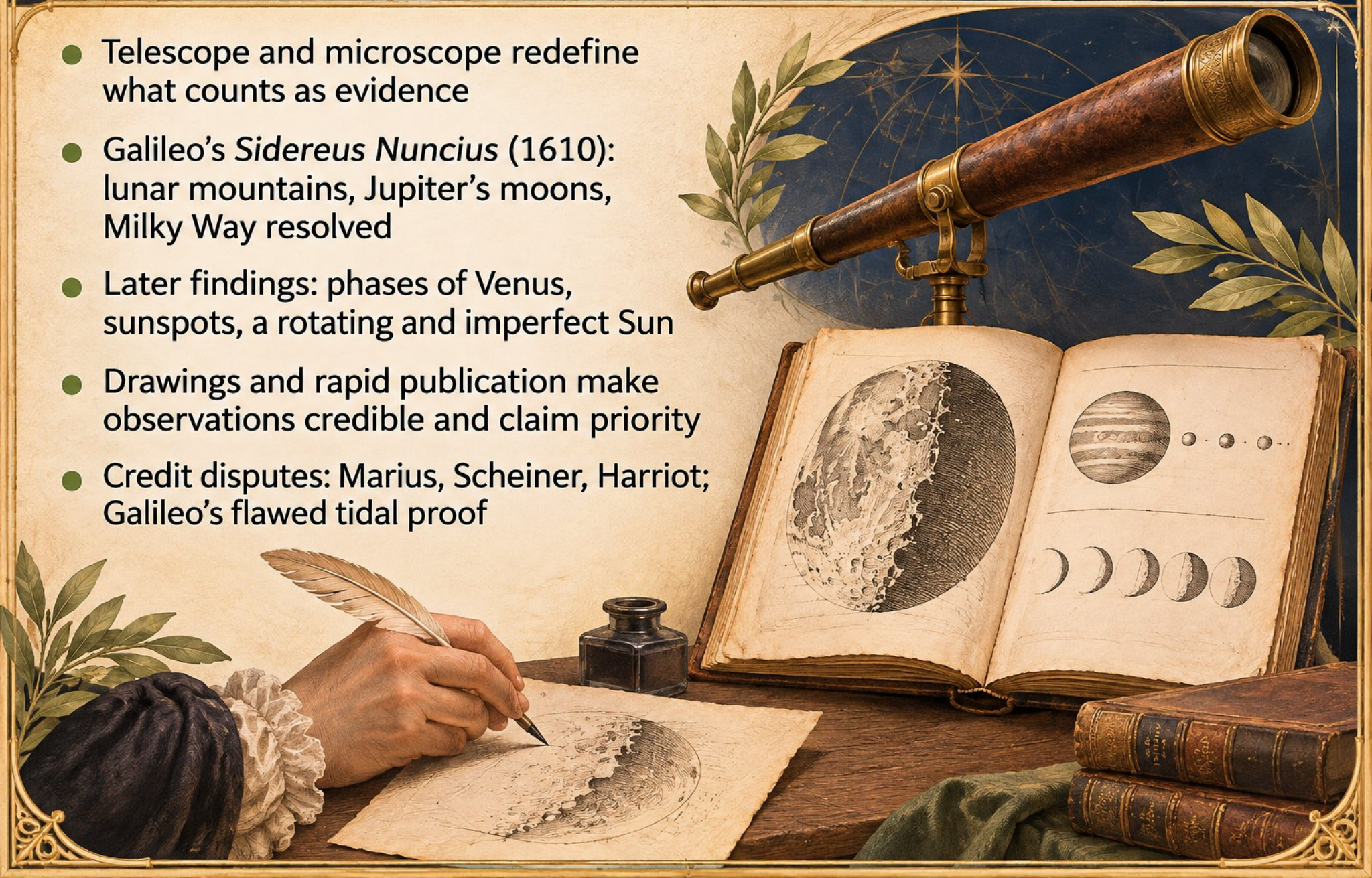
New Skies: Copernicus, Brahe, and Kepler

- Copernicus's *De revolutionibus* (1543) placed the Sun at the center
- His model still needed epicycles and perfect circles
- Brahe's precise pre-telescope data; 1572 nova and 1577 comet
- Brahe's hybrid model: planets orbit Sun, Sun orbits Earth
- Kepler's ellipses, equal areas, and period–distance harmony



Instruments, Observation, and the New Evidence

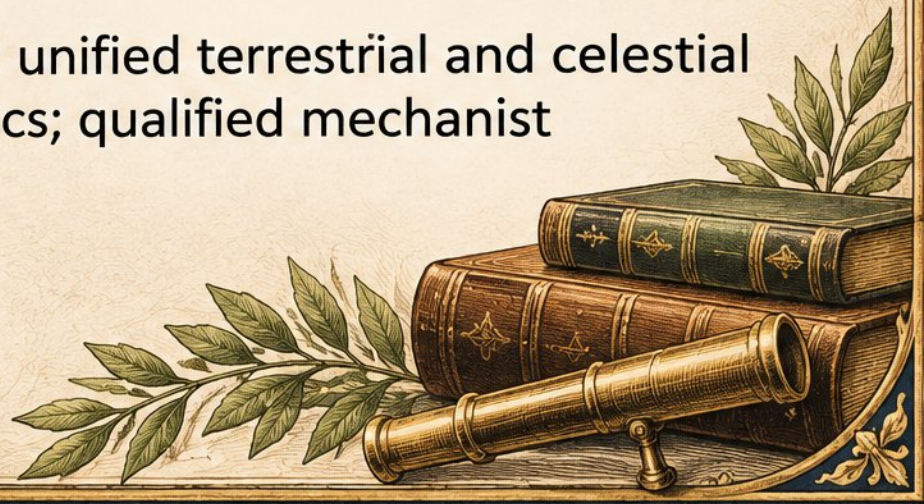
- Telescope and microscope redefine what counts as evidence
- Galileo's *Sidereus Nuncius* (1610): lunar mountains, Jupiter's moons, Milky Way resolved
- Later findings: phases of Venus, sunspots, a rotating and imperfect Sun
- Drawings and rapid publication make observations credible and claim priority
- Credit disputes: Marius, Scheiner, Harriot; Galileo's flawed tidal proof



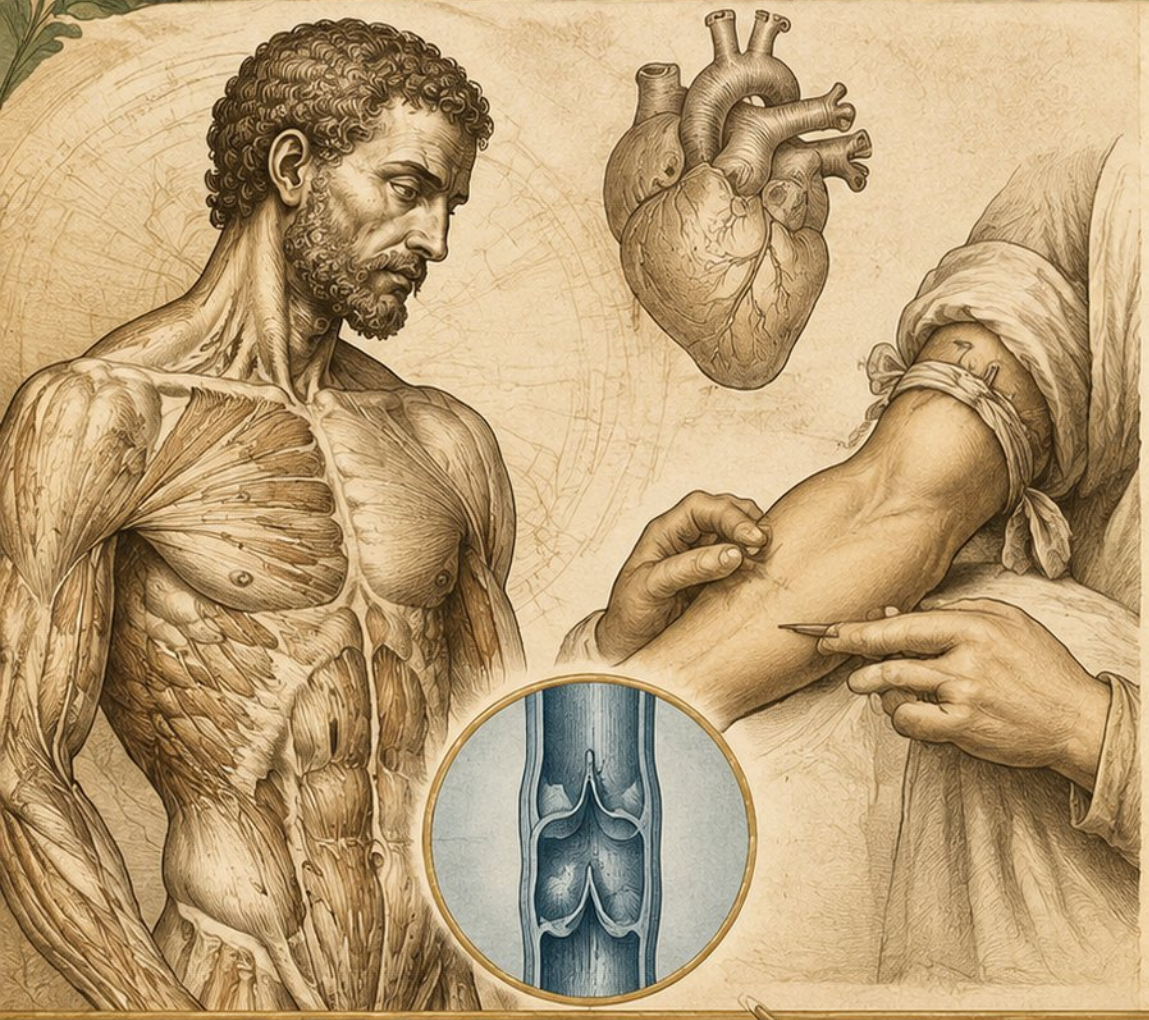


Matter in Motion:
The Mechanical Philosophy

- Explaining nature by matter, motion, size, shape, and collision—not purposes
- Descartes: plenist vortices, laws of motion, and mind-body dualism
- Bacon: experiment, eliminative induction, natural history, useful knowledge
- Boyle: corpuscles, air pump, and Royal Society experimental culture
- Newton: unified terrestrial and celestial mechanics; qualified mechanist



Bodies and Medicine: Vesalius, Harvey, and the Circulation of Knowledge

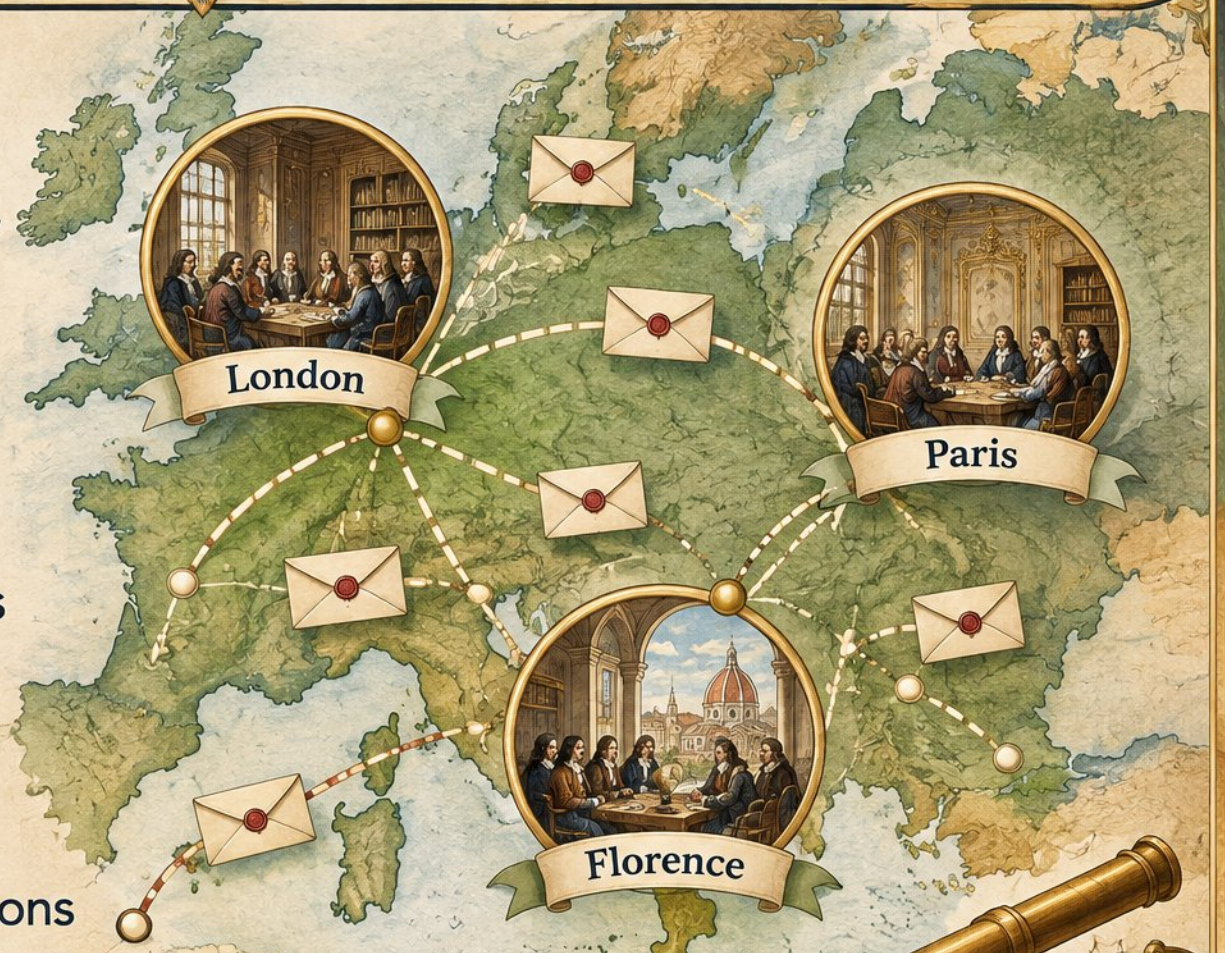


- Vesalius, *De humani corporis fabrica* (1543): human dissection and correction of Galenic anatomy
- Accurate illustrations made anatomy visible, reproducible, and teachable
- Harvey, *De motu cordis* (1628): experiment and quantification prove blood circulates
- Predecessors: Colombo on pulmonary transit; Fabricius on venous valves
- Galenic therapeutics persisted long after anatomical correction
- New knowledge travelled via print, dissection theaters, teaching, and correspondence



Institutions and Networks: The Social Life of Science

- Scientific academies: Royal Society (chartered 1662), Académie royale des sciences, Accademia del Cimento
- Correspondence and Philosophical Transactions (1665) managed reputation and priority
- Patronage, courts, and politics shaped natural philosophy, including Galileo's Medici ties
- Excluded voices: women, artisans, and merchants faced social limits in the new institutions



Science and Religion: Conflict, Accommodation, and Reform

- Galileo affair in context: 1616 admonition, 1633 trial, abjuration, house arrest
- Political pressures: Counter-Reformation, Tridentine rules on Scripture, Thirty Years' War
- Religious responses ranged from condemnation to natural theology and accommodation
- Draper and White's conflict thesis critiqued in favor of a complexity thesis
- Teach with primary documents from both sides, avoiding caricature



Did Nature Really Change? Continuities and Global Exchanges

- Real change in theory, method, instruments, and organized inquiry—not sudden or uniform
- Continuity thesis: medieval predecessors and slower, uneven transformation
- Global exchange: translation, trade, missions moved knowledge across Eurasia and Americas
- Caution: avoid Eurocentric, triumphalist master narratives
- Frame questions: what changed, for whom, and where?



Source-Based Classroom Activity: Interrogating Voices of the New Science

- Compare three key excerpts: Copernicus to Pope Paul III, Galileo's Letter to the Grand Duchess Christina, Newton's *Principia*
- Use document-analysis worksheet: author, audience, purpose, and reliability
- Run "Hot Seat": students defend positions using only source evidence
- Debate: did new science mainly challenge the Church or ancient authorities like Aristotle?
- Exit ticket and writing prompts aligned with historical-thinking skills



Object-Based Activity: Reading Instruments and Illustrations



- Treat instruments and illustrations as historical actors, not icons of progress
- Compare Galileo's lunar etchings with later depictions: observation, drawing, credibility
- Use Vesalius's anatomical plates to explore observation, artistry, and publication
- Notice print and publication as tools that made observations credible and claimed priority
- Adapt questions for high school, university, and museum audiences
- Connect historical instruments to how technologies shape evidence today

Museum and Exhibition Interpretation: Principles for Science Educators

- Begin with a 'big idea' and build an interpretive hierarchy
- Anchor narratives in real artifacts and social context, not technical chronology
- Layer information so visitors choose their own path and connections
- Write labels that acknowledge complexity and uncertainty without overwhelming
- Address audience preferences: ideas, people, objects, and physical interaction



Assessment Design: Measuring Historical Understanding



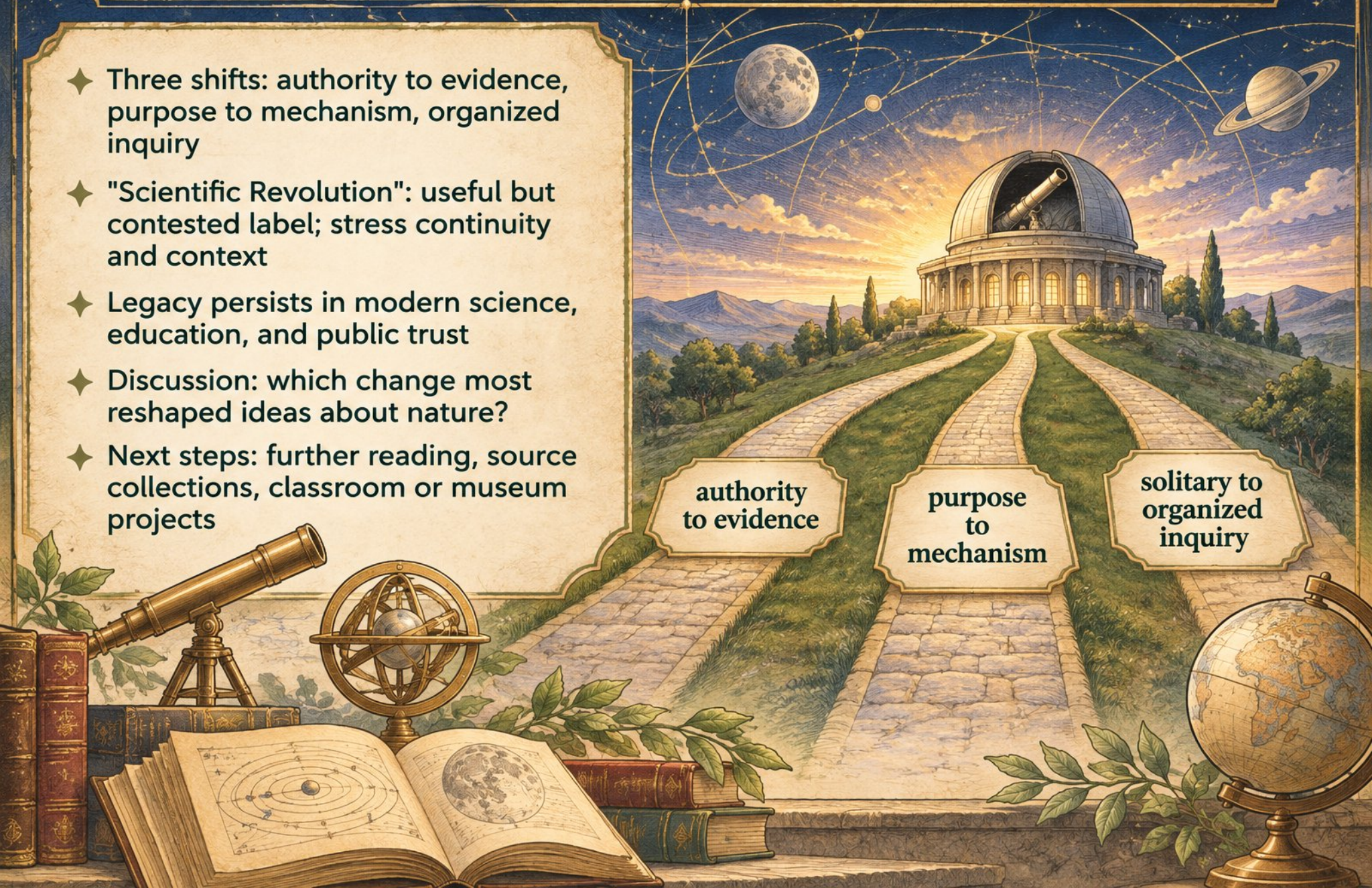
Audience Level	Task Type	Focus
High School	Short-Answer	Key developments and causal connections
University	Document-Based	Analyze sources and assess reliability
Teacher-Training	Thesis and Evidence	Build a supported argument with counterargument

- **Short-answer and document-based questions** test continuity, causation, and **source evaluation**
- **Prompt: "How did the new science challenge older authorities?"** — require cited evidence
- **Grading criteria include counterargument** and reliability analysis
- **Differentiate tasks for high school, university, and teacher-training audiences**
- **Formative checkpoints surface the misconception of a sudden, uniform revolution**



Wrap-Up: Key Takeaways and Discussion

- Three shifts: authority to evidence, purpose to mechanism, organized inquiry
- "Scientific Revolution": useful but contested label; stress continuity and context
- Legacy persists in modern science, education, and public trust
- Discussion: which change most reshaped ideas about nature?
- Next steps: further reading, source collections, classroom or museum projects



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