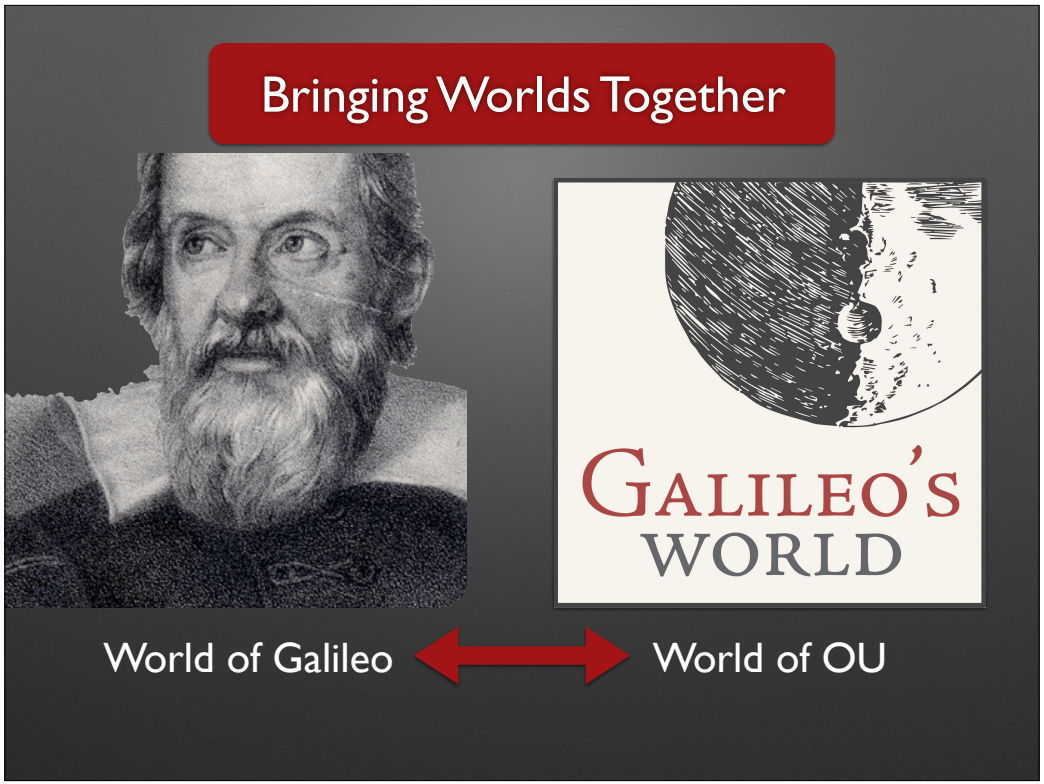
BRENT: We would like to share with you a pilot project for a University Library utilizing special collections to make OERs. At the end we will appreciate your guidance and suggestions, as we are very much at the beginning of this effort.

I'm Brent Purkaple, a graduate student in HSCI Department, AND
a GA in the Library for the History of Science Collections. I found the program via online course…

KERRY: I'm Kerry Magruder, Curator of the History of Science Collections in the Library. As a faculty member in the History of Science Department, I have frequently taught the online course Brent mentioned, often lamenting the dearth of quality OERs for the history of science.

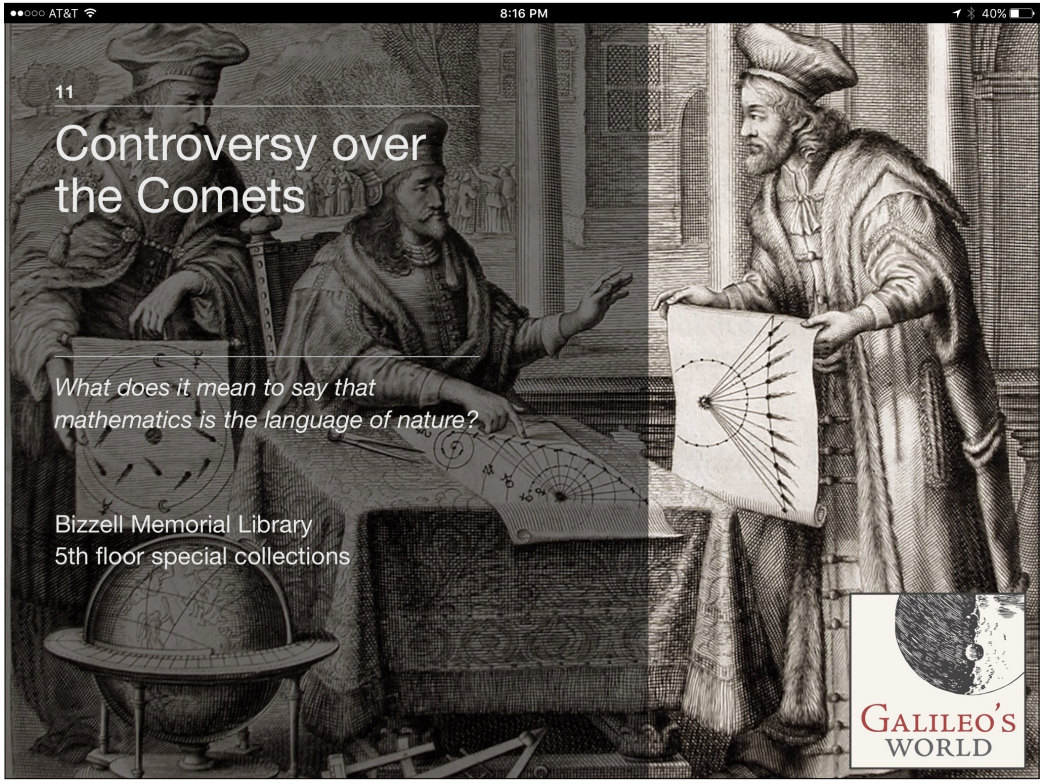
BRENT: We should also mention Stacy Zemke, a past participant at this conference who could not make it this year. We thank her for encouraging us to come and share our story, although if she were here, you would hear a better talk.

BRENT: Let's look at some of the open educational resources being developed alongside OU's Galileo's World exhibition.

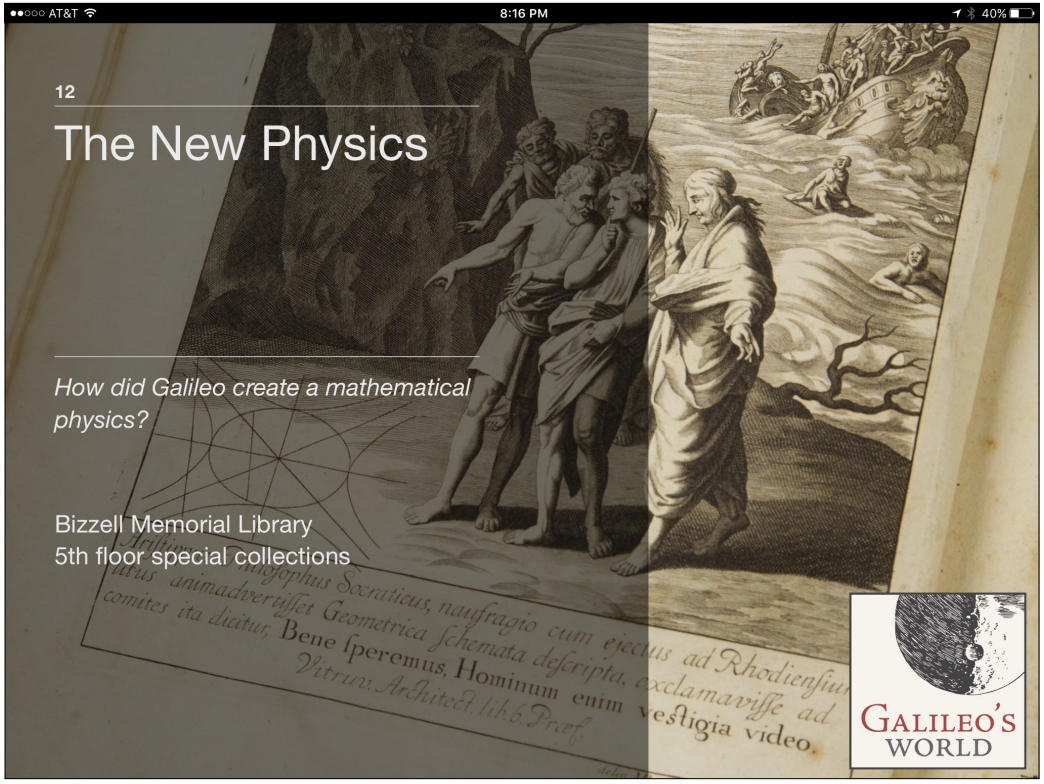


KERRY: The theme of Galileo's world is • "bringing worlds together. We are connecting the • World of OU with • the World of Galileo.

Galileo's World is an exhibition without walls. It is appearing over the course of the academic year in 21 galleries in 8 locations across the OU campuses of Norman, Oklahoma City, Tulsa and even Arezzo.



We can't take time to introduce all the different galleries, but here are some Exhibit Guide screenshots for a few. (Read titles)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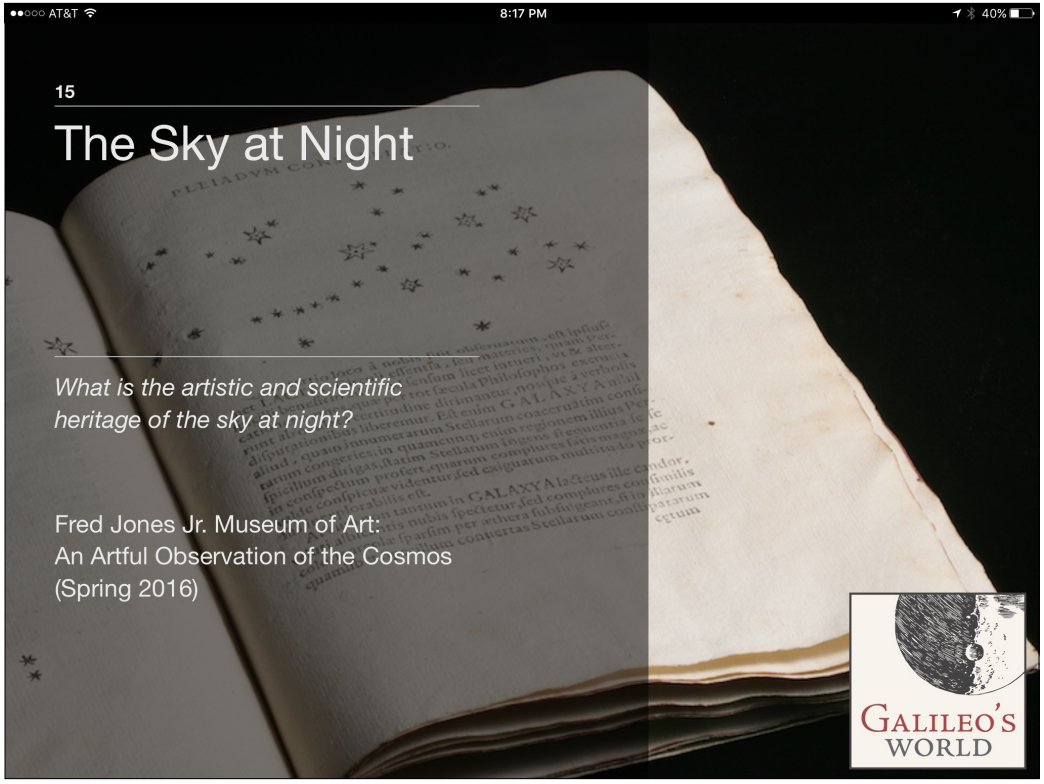
The New Physics
How did Galileo create a mathematical physics?
Bizzell Memorial Library
5th floor special collections
GALILEO'S WORLD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The Sky at Night
What is the artistic and scientific heritage of the sky at night?
Fred Jones Jr. Museum of Art:
An Artful Observation of the Cosmos
(Spring 2016)
GALILEO'S WORLD


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Chapter 16
The Moon and the Telescope
Overview
16.1 The Moon and the Telescope
RECENS HABITAE.
Vnum
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704
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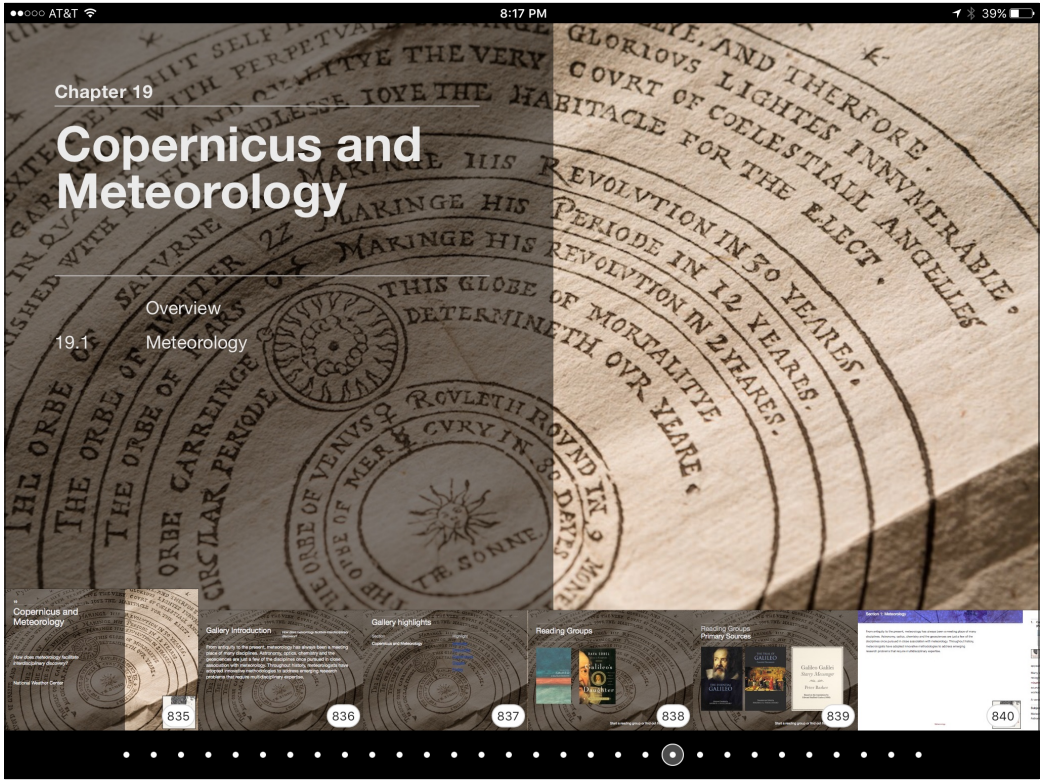
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Chapter 19
Copernicus and Meteorology
Overview
19.1 Meteorology
Copernicus and Meteorology
835
Gallery Introduction
836
Gallery highlights
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Reading Groups
838
Reading Groups
Primary Sources
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Chapter 20
Galileo and Kepler
Overview
20.1 Kepler
Galileo and Kepler
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Gallery Introduction
866
Gallery highlights
867
Reading Groups
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Reading Groups
Primary Sources
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Exhibit videos
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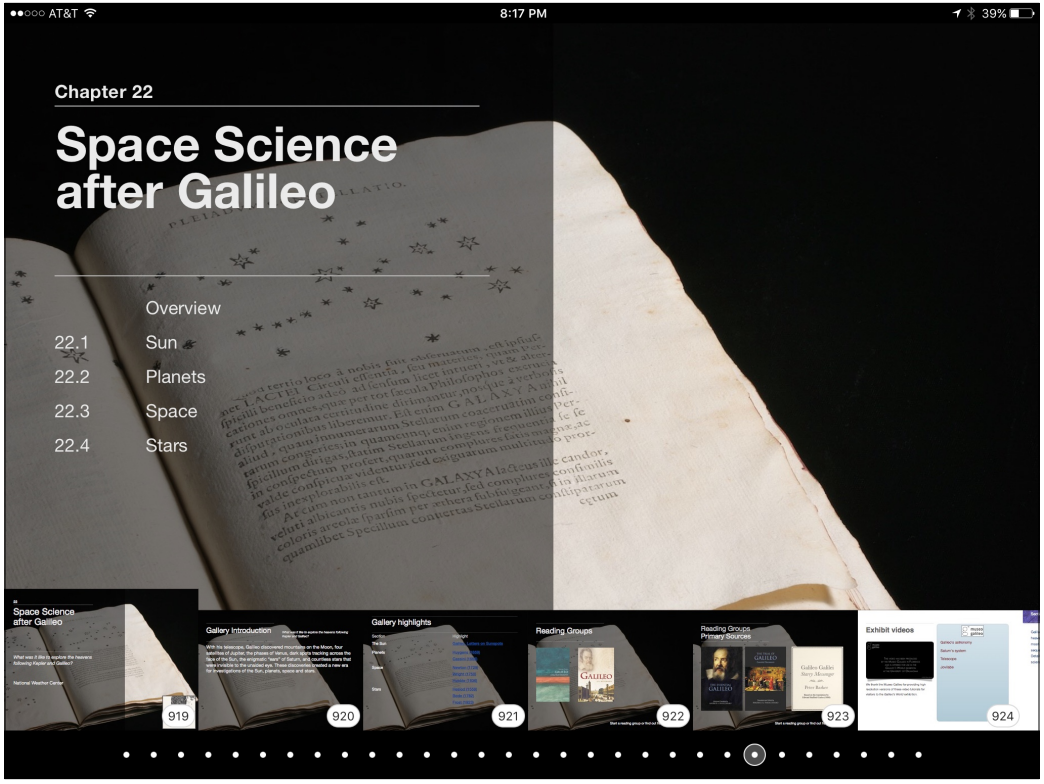
Chapter 21
Galileo and Experimentation
Overview
21.1 Academy of Experiments
Galileo and Experimentation
891
Gallery Introduction
892
Gallery highlights
893
Reading Groups
894
Reading Groups Primary Sources
895
Exhibit videos
896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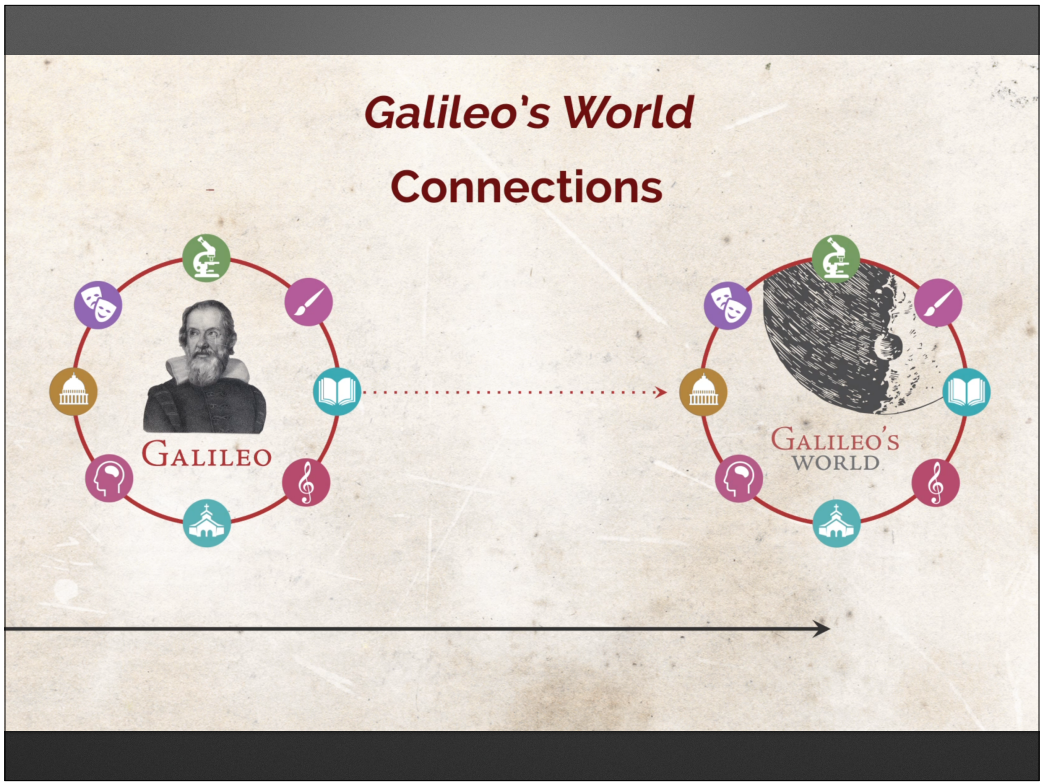
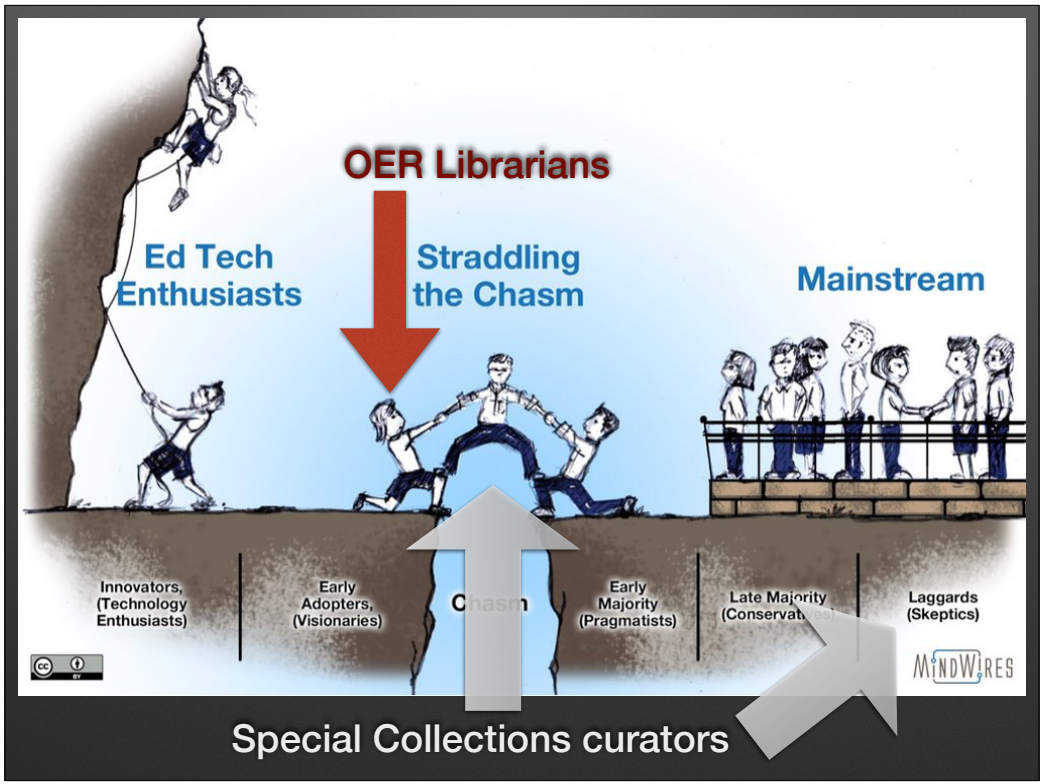
Chapter 22
Space Science after Galileo
Overview
22.1 Sun
22.2 Planets
22.3 Space
22.4 Stars
Space Science after Galileo
919
Gallery Introduction
920
Gallery highlights
921
Reading Groups
922
Reading Groups Primary Sources
923
Exhibit videos
924

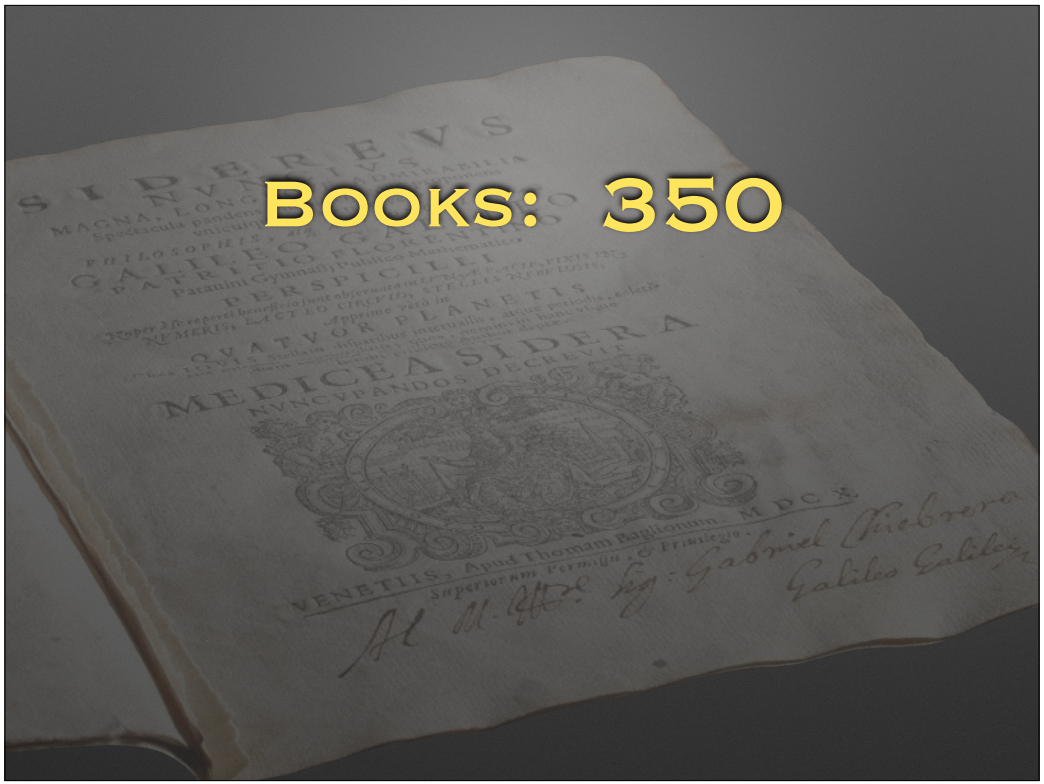


So the overall purpose of the Galileo's World exhibition is to explore Connections – between the world of Galileo and our world today, and across the natural sciences and humanities.

BRENT: What are our goals for making OER's? • First, we want to model an OER role for special collections.



OER Librarians are among the innovators and early adopters, recruiting special collections curators who are straddling the chasm or wondering if physical items still matter. Yet special collections offer distinctive resources, opportunities for undergraduate research, and immense potential for library-based creation of oers.



KERRY: The Galileo's World exhibition features 350 rare books on display, selected from nearly 100,000 volumes in the History of Science Collections.

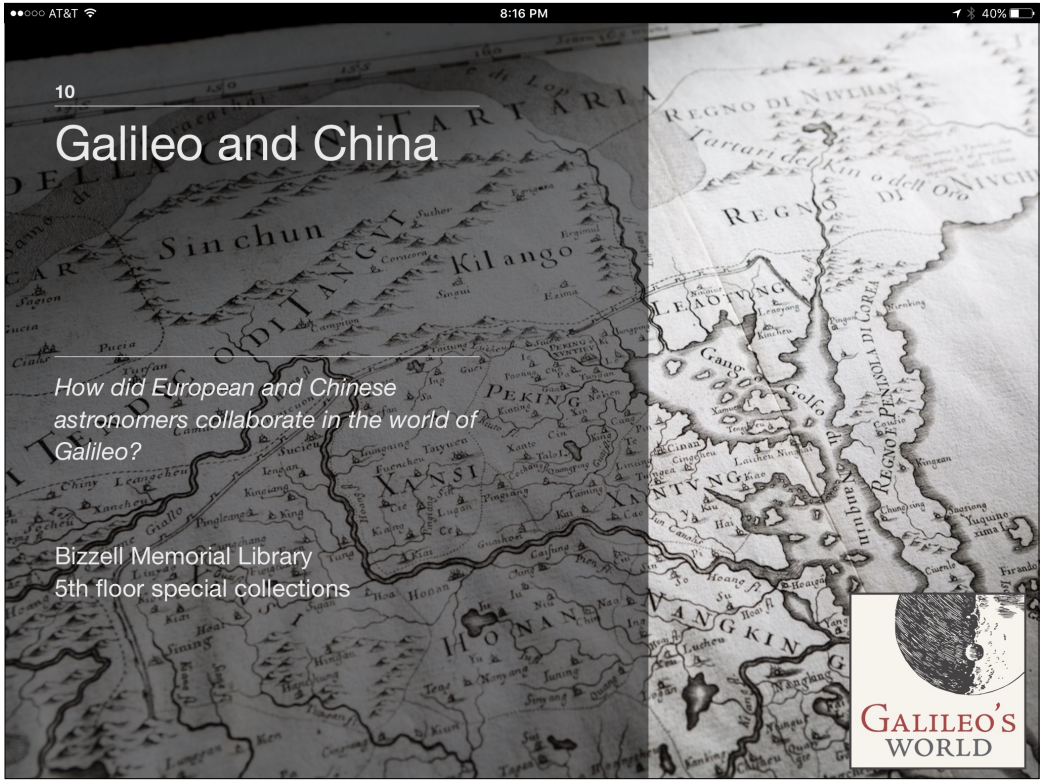
These are amazing books — here is Galileo's Starry Messenger, the first report of observations made with a telescope. The OU copy is the only extant copy with Galileo's handwriting. OU has all 12 Galileo first editions, 4 of which contain his own handwriting.

The exhibit includes dozens of first editions…

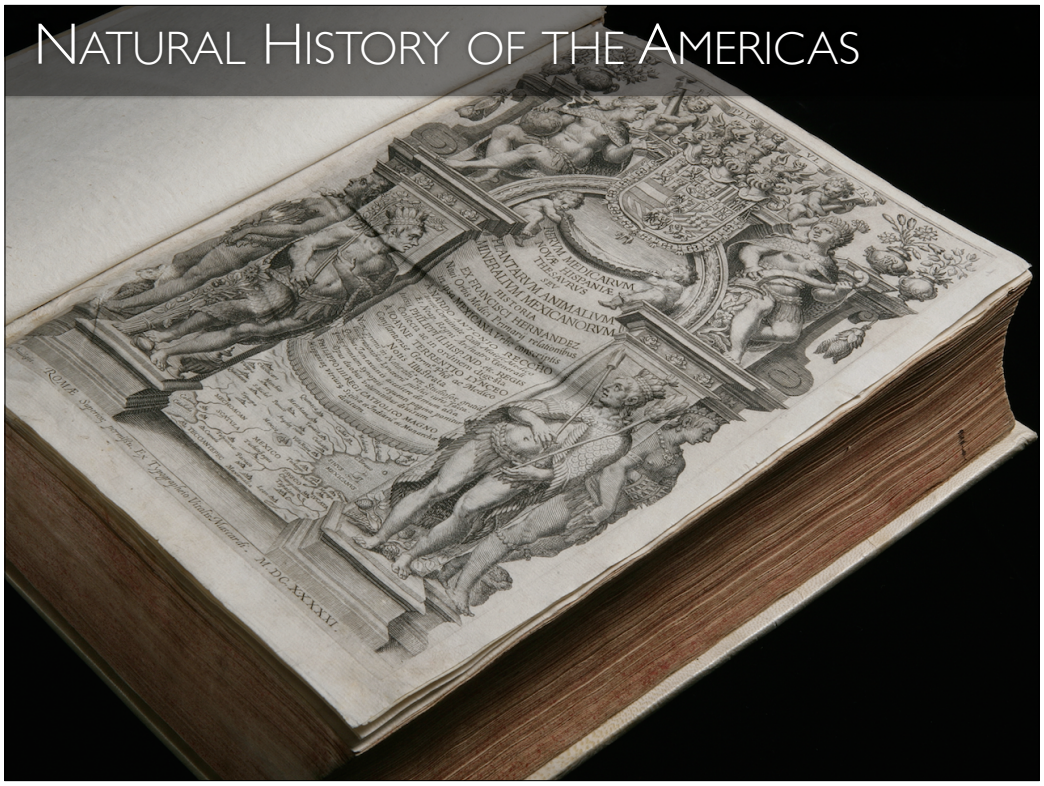
But the 350 books are not dusty tomes sealed up in cases to be admired as treasures. • They are displayed because they tell stories in the thousands!

Let’s look at three quick stories. First, consider this book, bound and cased in a typical Asian style.

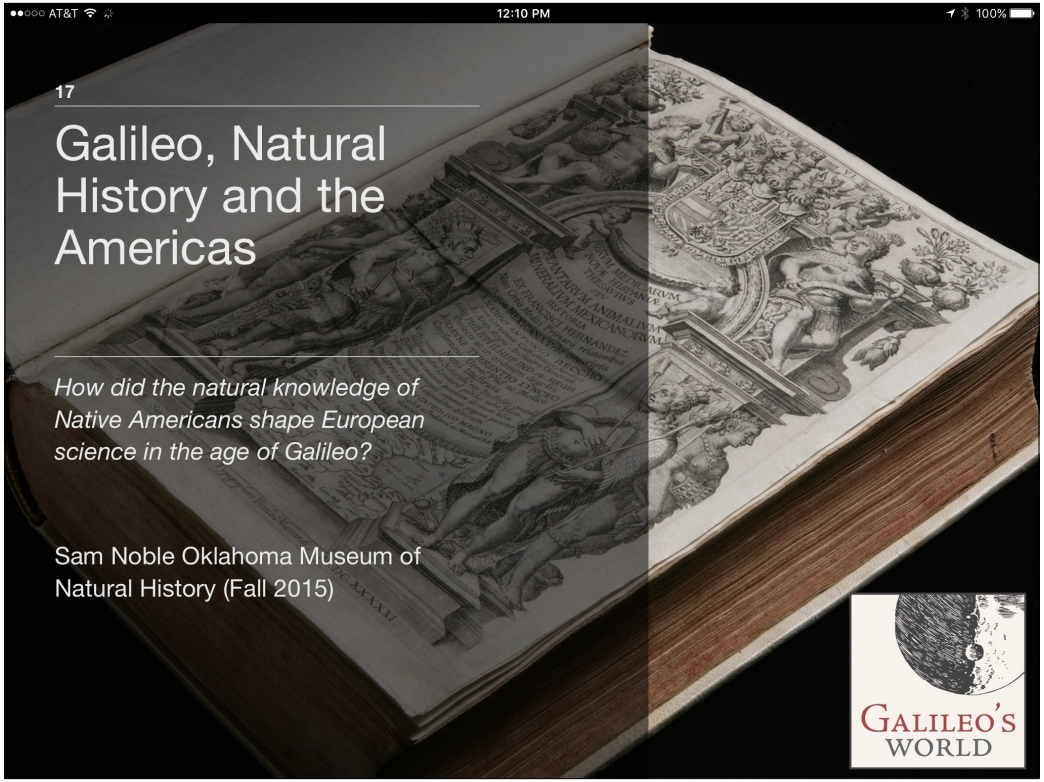
Johann Schreck was a friend of Galileo's who assisted him during his telescopic discoveries. A few years later, Schreck went to China, where he wrote this work on engineering in Chinese.



Galileo's world extends to Asia, focusing on how European and Chinese astronomers collaborated for over a century.



Here's a second story. This book, by Francisco Hernandez, is the most important early natural history of the Americas. Hernandez spent a decade with the Aztecs in central Mexico. Galileo and his colleagues in the Academy of the Lynx published it in 1651.



Native American biology and medicine shaped European science in the age of Galileo. We tell this story with an exhibit at the OU Natural History Museum.

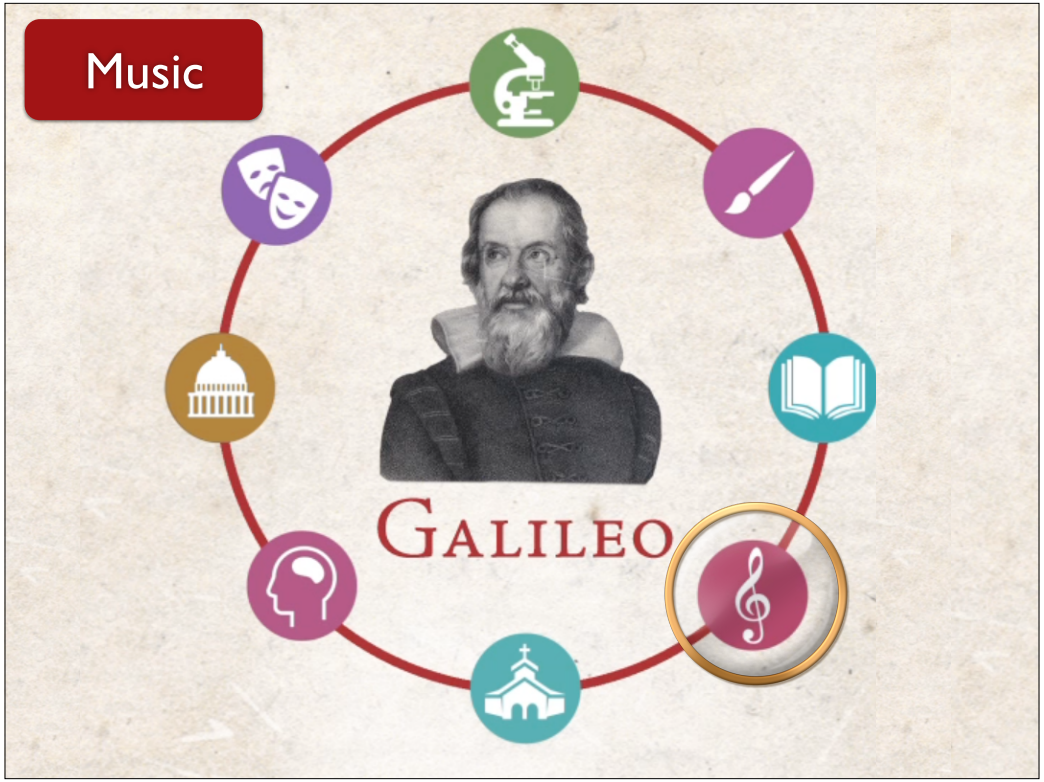
Consider a third story: Johann Hevelius was the leading European telescopic observer in the mid-17th century. This massive book was the first comprehensive lunar atlas. It accurately mapped the Moon less than 40 years after Galileo's telescopic discoveries.

On the frontispiece, Hevelius portrays Ibn al-Haytham, a leading medieval Islamic astronomer and optical theorist.

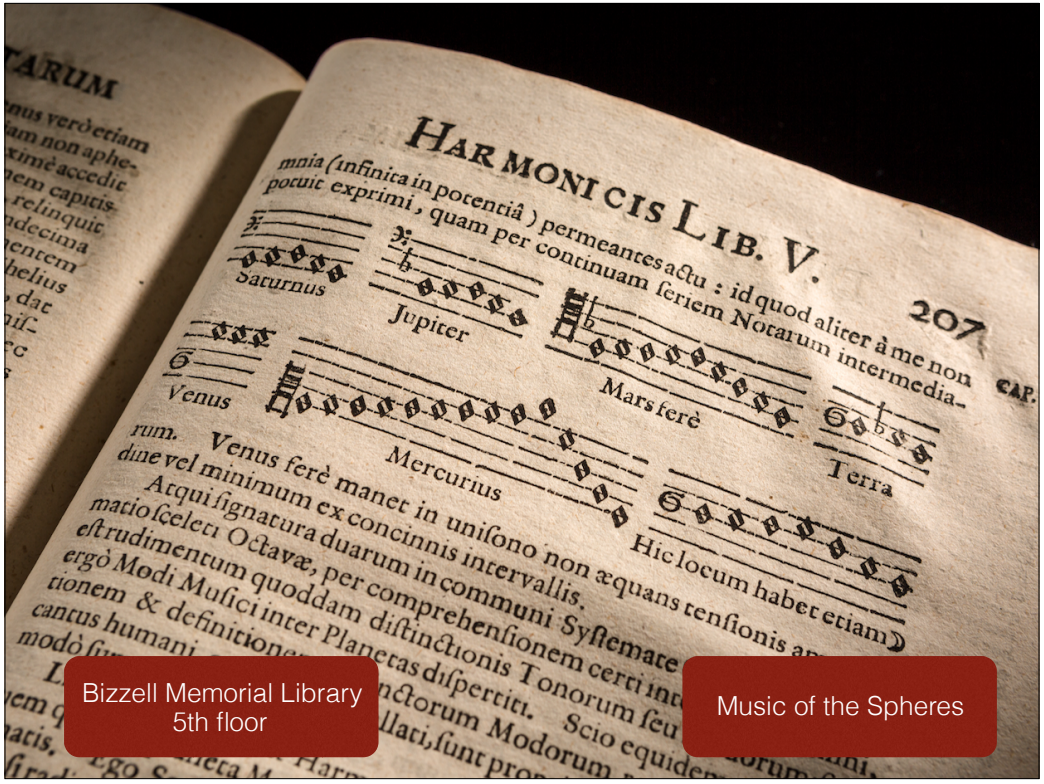
On the right, holding a telescope, is Galileo. Who would have guessed that one of the most impressive works of the scientific revolution would portray Galileo in Middle Eastern dress as a tribute to medieval Islamic science?
So with three quick stories, we've seen that Galileo's world brings together worlds as far removed as Asia, America and the Middle East.

Here are some top 10 books for particular cross-cutting themes. • Here are a few more… The top 10 tours go across all the galleries. • For example, every gallery has something to say about women and science.

BRENT: This leads us to our second goal, which is to increase awareness of how the history of science provides multi-disciplinary impact, making connections with cross-cutting resources. No matter what the subject area, OERs in the history of science have the potential to enhance learning across the curriculum.



KERRY: The history of science helps us envision a circle of subject areas and recover connections that may have been lost in our overspecialized training. • For an example, let's look in particular at the worlds of astronomy and music.



In the Music of the Spheres gallery, visitors see that Kepler's third law, presented in every astronomy textbook today, was originally expressed in musical notation!

72 HARMONICIS LIB. III.

CAP. XIV. Hoc pacto in nostris XIV. speciebus reperiuntur interspersæ aliæ X. quaternis primis locis coincidentes cum prioribus, aut etiam quinis; ubi verò incipiunt differre, præmissa est particula, *vel*,

Quod si jam accesserit ultima causa, discriminans Tonos, scilicet τομὴ & τετρὰς: triplicabitur Numerus, & fient 72. species. Omne enim sceleton Octavæ ex omnibus 24. habet & tertiam & quartam concordantem cum primâ, & quintam & sextam. Si ergò hæ partes canrus potissimùm circa quartam & sextam occupentur, tunc statuunt infimo loco Diatessaron: Sin circa tertiam & sextam, Diatessaron est

in medio, sin denique circa tertiam & quintam, Diatessaron est loco supremo.

Hæc autem non ideò dico, quod necessaria sit tam minuta concisio, cùm sciam, plerumq; misceri ternas formas in uno cantu: sed ut ex hoc numero possit judicium ferri de discriminibus Tonorum, quæ Moderni tradunt, quæ partim talia sunt, ut mihi videantur illorum tot status posse, quot sunt omninò cantiones, cætera unius Toni. At si observamus hæc principia, numerus Tonorum utcunq; magnus, finitus tamen est. In summâ, Toni realibus distincti metis & discriminibus, non respectu altitudinis vocis in Organo, sed in ipsâ etiam humana voce, quæ principium naturalis Systematis à quacunq; voce altâ vel profundâ facere potest, sunt vel 3. tantùm, vel 12, vel 24, vel 72.

Cum his principijs meis sic ego concilio Tonos octo vulgares, quos Ecclesiasticos dicunt; eranteq; veteribus, opinione quorundam,

I. Dorius I. Hypodorius

Adam primus Homo. *Noe secundus.*

Hæ sunt duæ species Cantus mollis, ex specie octavæ, quæ est mihi Prima inter XIV. Nec video aliam differentiam, quàm in altitudine meâ, quàm primus habet majorem, secundus minorem: nisi velis illos per causam ultimam distinguere, quòd primus quidem observet hoc scheleton, secundus hoc.

Tertius vulgaris Phrygius Quartus vulgaris Hypophrygius.

Tertius Abraham, *Quatuor Evangelistæ.*

Nihil

HARMONICIS LIB. III. 73

Nihil manifestius quàm hos duos Generis duri pertinere ad nostram speciem XI. & scribendos ex *e*, estq; rursùm vix ullum discrimen aliud quàm * altitudinis, nisi hæc illis velis accomodare scelcta seorsim.

CAP. XV.

Triplex est altitudo Toni I. absoluta & materialis quodammodo, ut in voce humana etiamsi in Organis sit ex ordinatis ut ex radix Systematis ut ex, ubi non mutatur forma Systematis: de hac jam nihil. 2. Formalis ipsius radicis cujusq; Toni in Systemate naturali compositi ex duobus diapason. Neq; hæc hoc loco intelligitur: importat enim orientationem Toni per mutationes Clavium in dicali Systematis ferè Formalis, altitudo Melodiæ respectu suæ radicalis clavis, quà manente quidem Tonus idem, sed aliud quasi schema indutus ut si non ad Octavam radicis ascendat, sed infra sextam, quintam aut quartam se coniungat, vel infra radicem sese circumferat, redeat tamen in finem ad radicem. Itaq; scelera ista non hic intelligenda, qualis Modus omnes ejus arcicolos vel notas

Quintus vulgaris Lydius. Sextus vulgaris Hypolydius.

Quinq; libri Mosis *Sex hydriæ positæ*

Et hi similiter manifestissimè scribendi sunt ex *f*: sunt q; generis mollis, distinguuntur q; altitudine vel scelcteis hisce, ex nostra XIII.

vel

Septimus vulgaris Mixolydius. Octavus vulgaris Hypomixolydius.

Septem artes liberales *Et octo sunt partes.*

Etsi apparet consilium inventorum, quòd Primum & Secundum ex *d.* scribere voluerint, Tertium & Quartum ex *e.* Quintum & Sextum ex *f.* Septimum & Octavum ex *G.* certumtamen est ex ijs quæ supra disputavimus, etiam hos generis Duri cum Primo & Secundo ex eadem clavi *G.* scribi debere, quibus ex nostrâ specie II. competunt hæc scelcta.

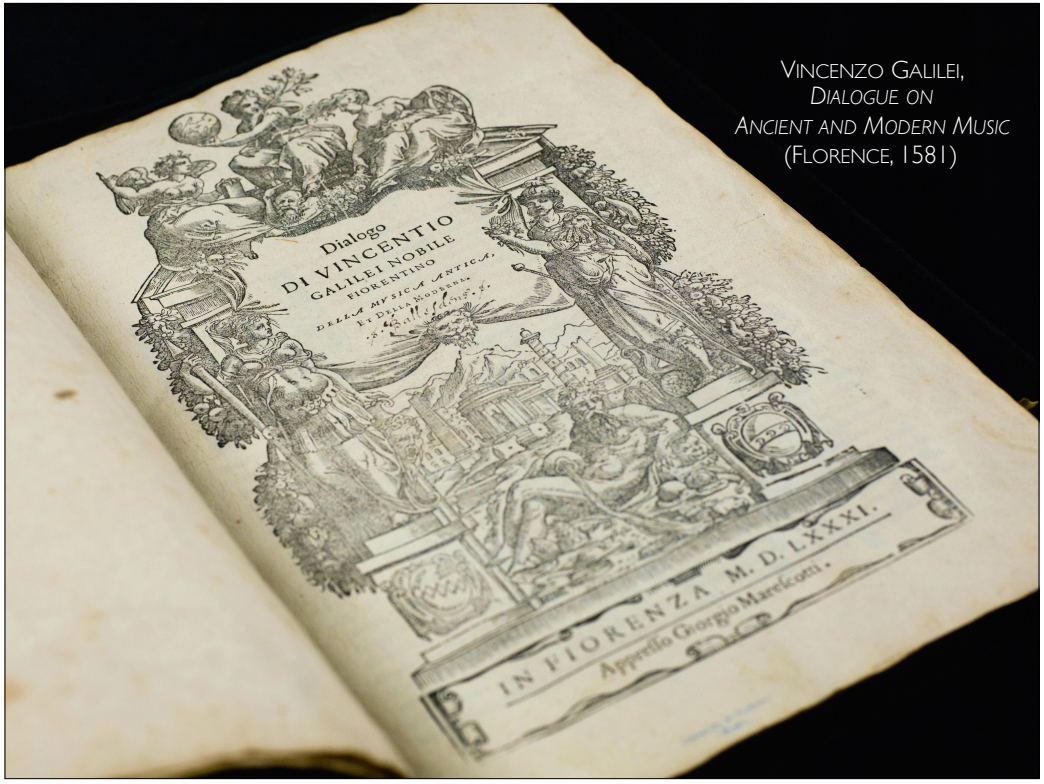
Hæ igitur applicatione vulgarium octo Tonorum ad meas species Octavæ I. XI. XIII. II. ego multò evidentius discrimen ostendere possum inter hos Tonos, quàm Musici nostri, quia comma contemnunt. Qui enim ex *G.* scribuntur, omnes quatuor habent consonantias legitimas, tertiæ, quartæ, quintæ, & sextæ cum primâ. Qui verò ex *F.* & *e.* consonantijs utuntur adulterinis, infrà quartâ majori *e a.* & *f bb.* & quinta majori *e bb.* & *f cc.*

Quid igitur cum reliquis decem speciebus, inquies? cùm omnes usitati Toni redigantur ad quatuor? Nimirum ad hoc serviunt, ut sciant Musici, si Systemata principalis Octavæ ex *G.* descriptæ, temperemus ut natura suadet; tunc nequaquàm ita facilè & variè transponi posse eantum sine mutatione sinceritatis suæ, ut ipsi habent in usu. Liberum igitur illis est, vel rejicere omnes reliduas 10., & cum ijs etiam transpositiones suas: vel fateri, quòd plures Formæ Melodiarum, plures nempe Modi vel Toni possint existere, ijq; differences ab his positis, alij

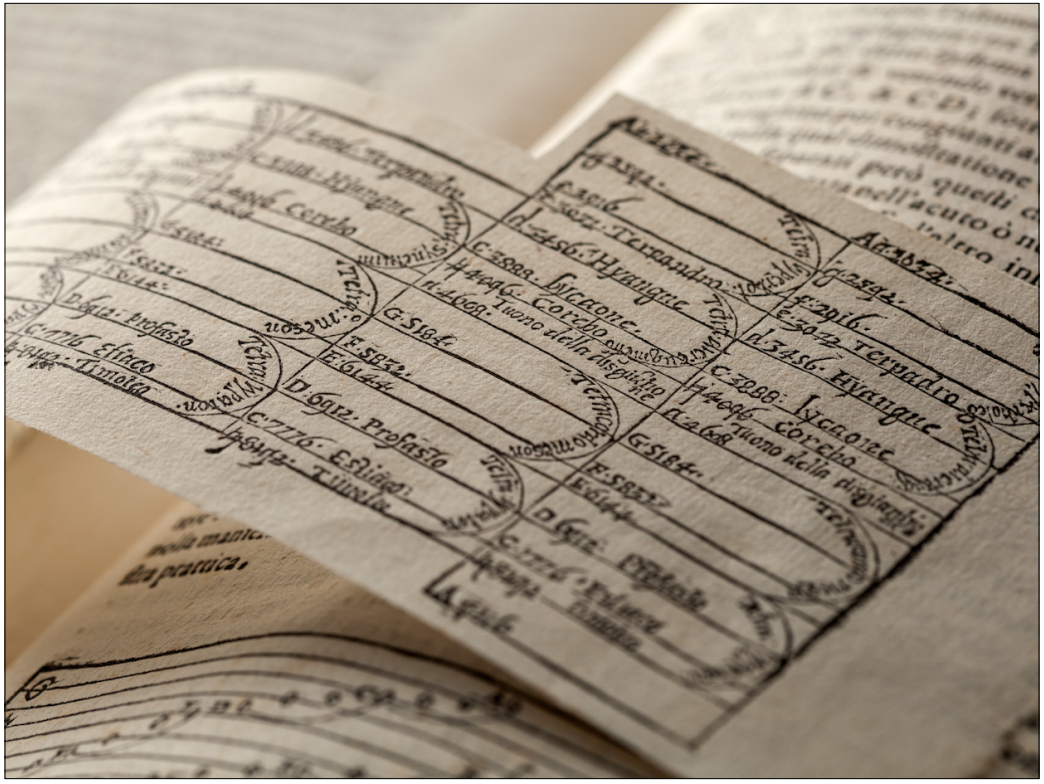
Kepler achieved a synthesis of his new astronomy with recent polyphonic musical theory.

Jonathan Annis, an OU graduate student in music composition, has composed a suite for harp, flute and oboe entirely based upon musical themes from Kepler's book. Jonathan arranged the themes, but they're all from Kepler's musical description of the universe as a cosmic dance. • [listen to a sample]

We will perform the entire suite sometime this year, and make a recording widely available as an OER.



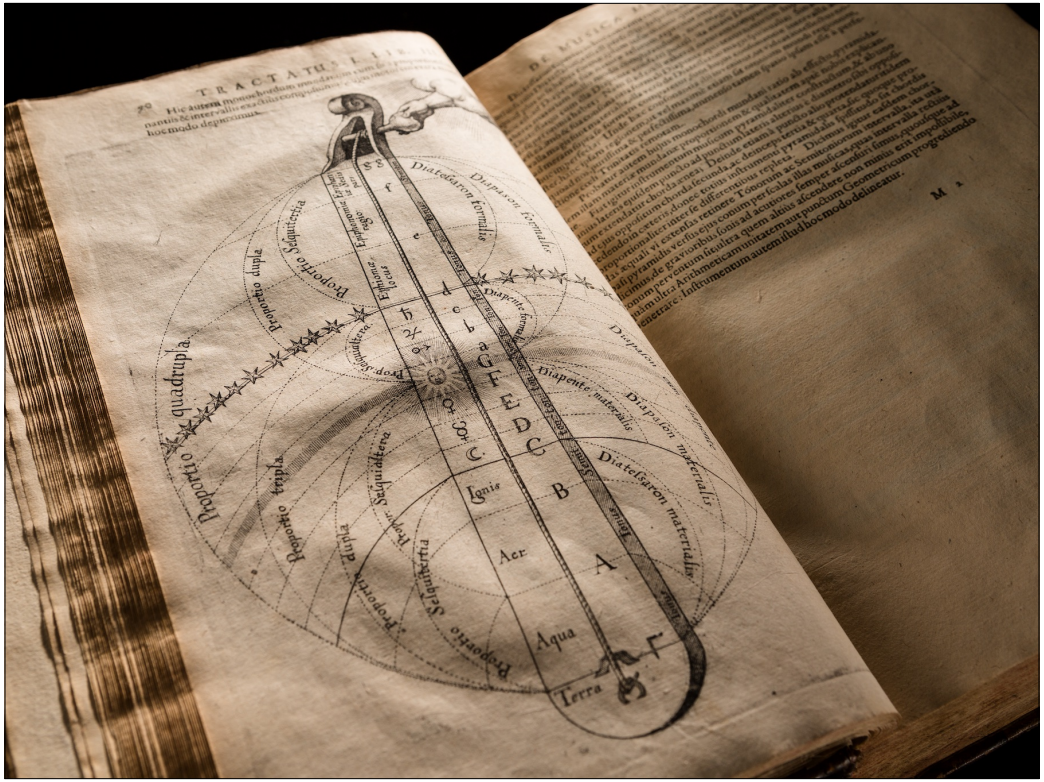
Galileo's father, Vincenzo Galilei, published a Dialog on music theory in 1581.



Vincenzo was one of those responsible for the birth of Italian opera.

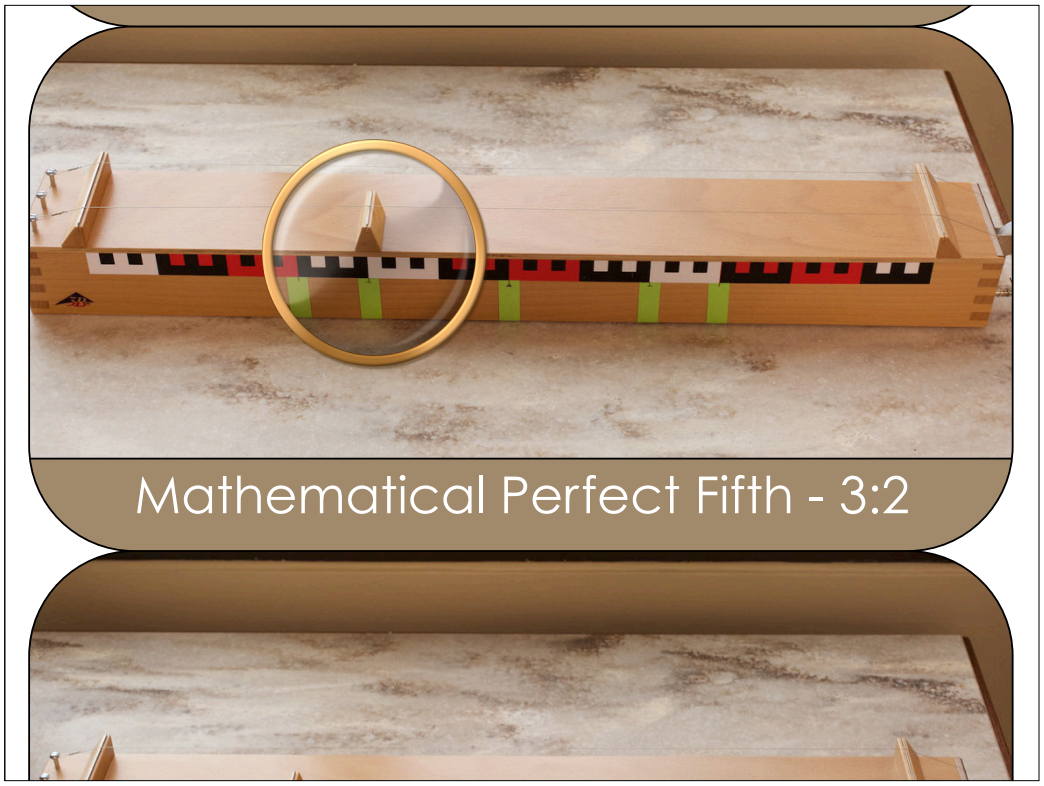
When Galileo conducted his inclined plane experiments, he measured the times of the balls to “within a 10th of a pulsebeat.” Friends who were not musicians, were not able to successfully replicate the experiment. It’s still difficult to replicate today! Galileo’s science was made possible because of his skill in music.

Two weeks ago, the School of Music presented an opera by Monteverdi that reflects Vincenzo's influence. OERs include more than just information in text form. This artistic performance will soon be posted online. The history of science is not just for scientists, but embraces both music and astronomy together.



BRENT: According to Robert Fludd, a London physician contemporary with Galileo, the universe itself is a monochord, a musical instrument.

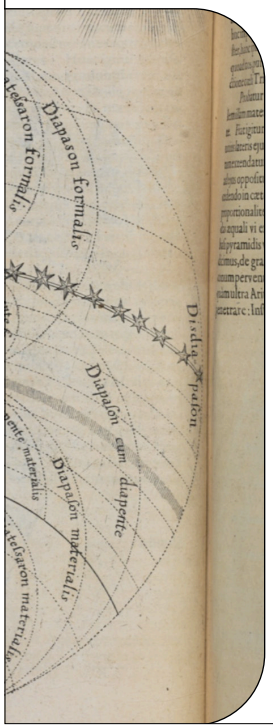
In the Music of the Spheres gallery, visitors explore the connections between mathematics and music with a duochord. Here a bridge divides a string into two equal halves. The long string and the half string are an octave apart.



Divide the string into three equal segments, and the 2/3rds string and the original string produce the harmony called a perfect fifth.

Divide the string into four equal segments, and the 3/4ths string and the original string produce the harmony called a perfect fourth.

below?



Astronomy & Music: Introduction to the Duochord

The ancient Pythagoreans envisioned the heavens as celestial spheres rotating according to harmonious music. For Robert Fludd, the universe was a monochord, its physical structure unintelligible without an understanding of music. Galileo's father, Vincenzo Galilei, experimented with pitch and tuning.

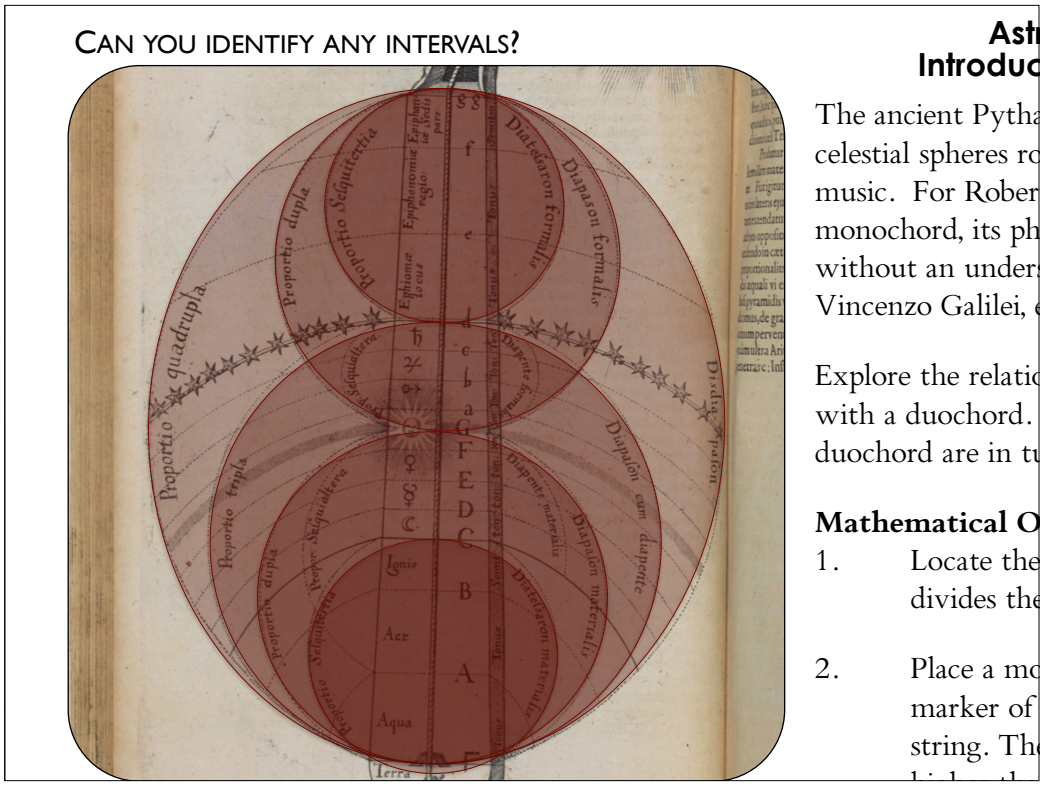
Explore the relations between music and mathematics with a duochord. Make sure that the strings of the duochord are in tune with one another.

Mathematical Octave - 2:1

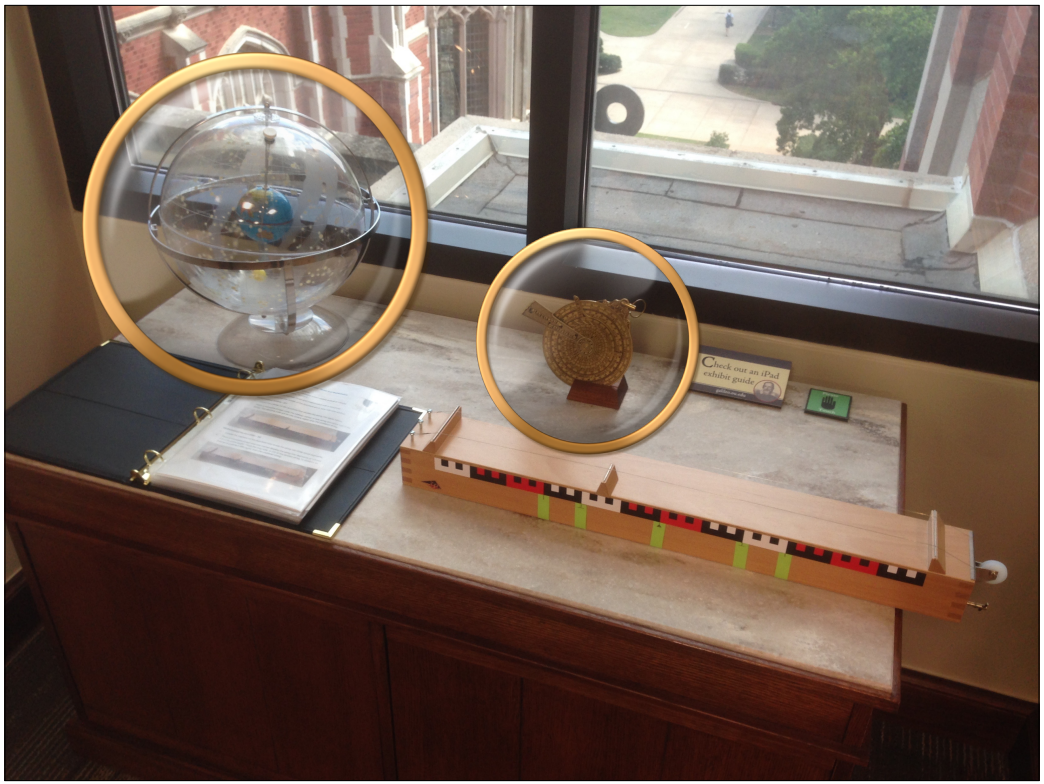
1. Locate the marker on the duochord that divides the string into *two equal halves*.

2. Place a moveable bridge under the halfway marker of one string and pluck half of the string. The resulting note will be one octave

Each stand-up activity is connected to specific exhibit objects. In this case, Pythagoras, Fludd and Vincenzo Galilei.

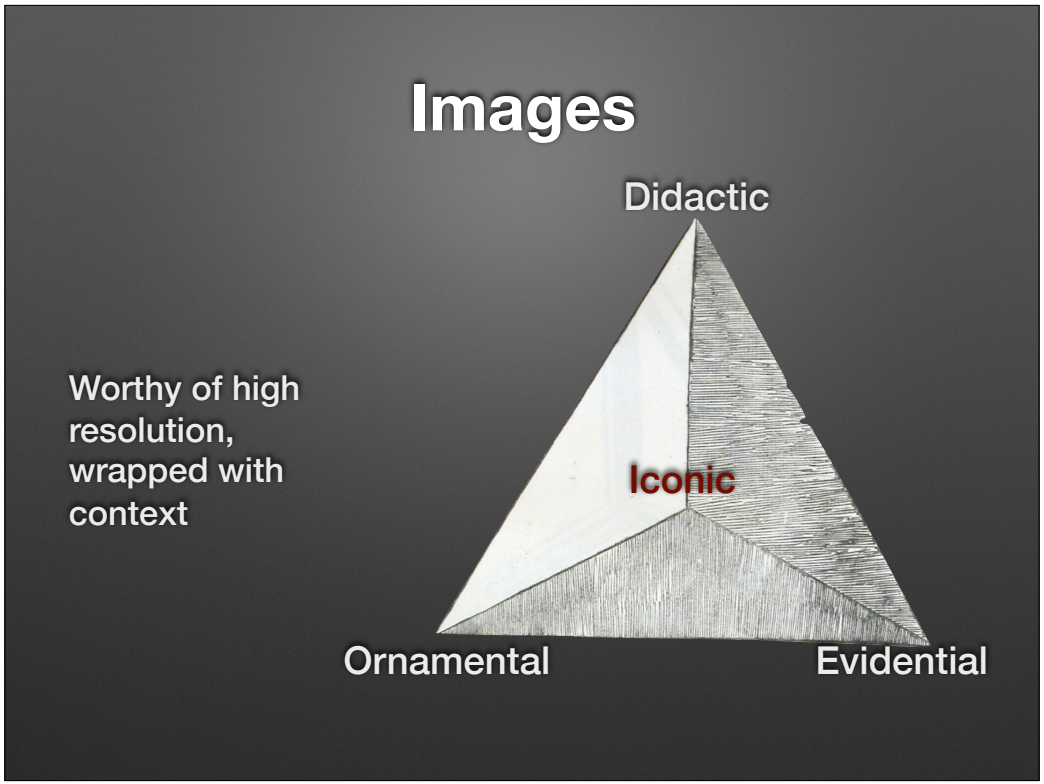


Many contain an open-ended question, such as “Can you identify any intervals?” These questions may prompt reflection on an original image from a book.

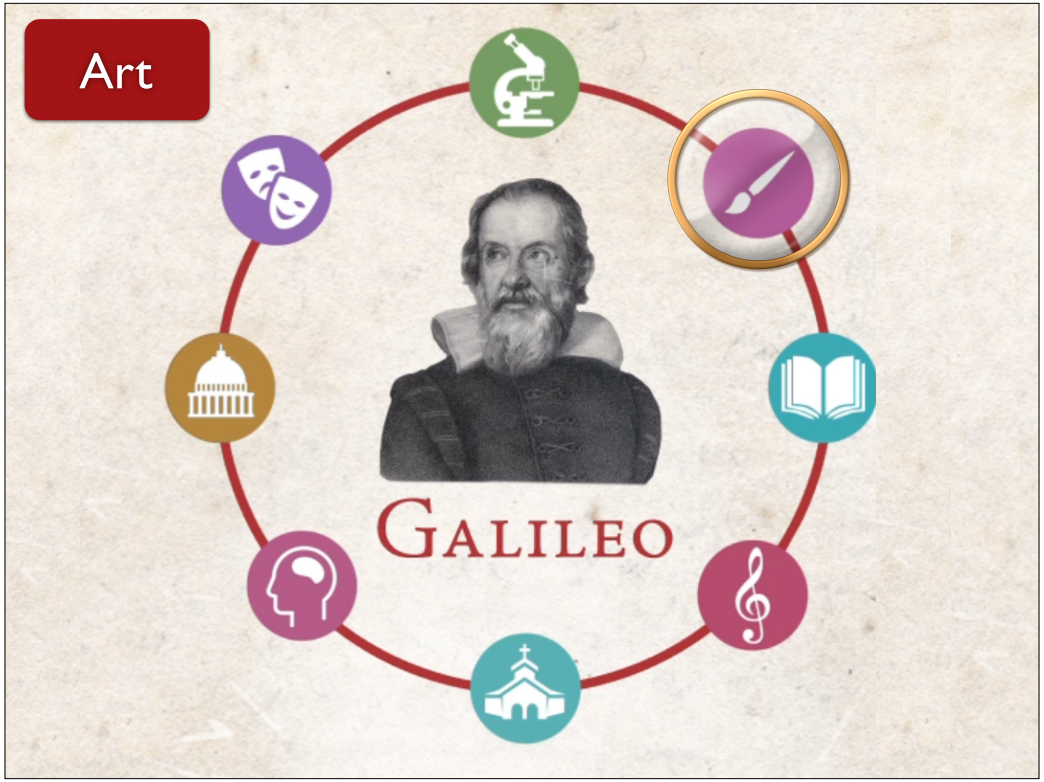


In addition to the duochord, the Music of the Spheres activity station offers stand-up activities for the celestial sphere, and • an introduction to telling time by the stars with the nocturnal dial. There are two dozen such stand-up activities in the 5th floor exhibit hall, each of which we are preparing as an OER.

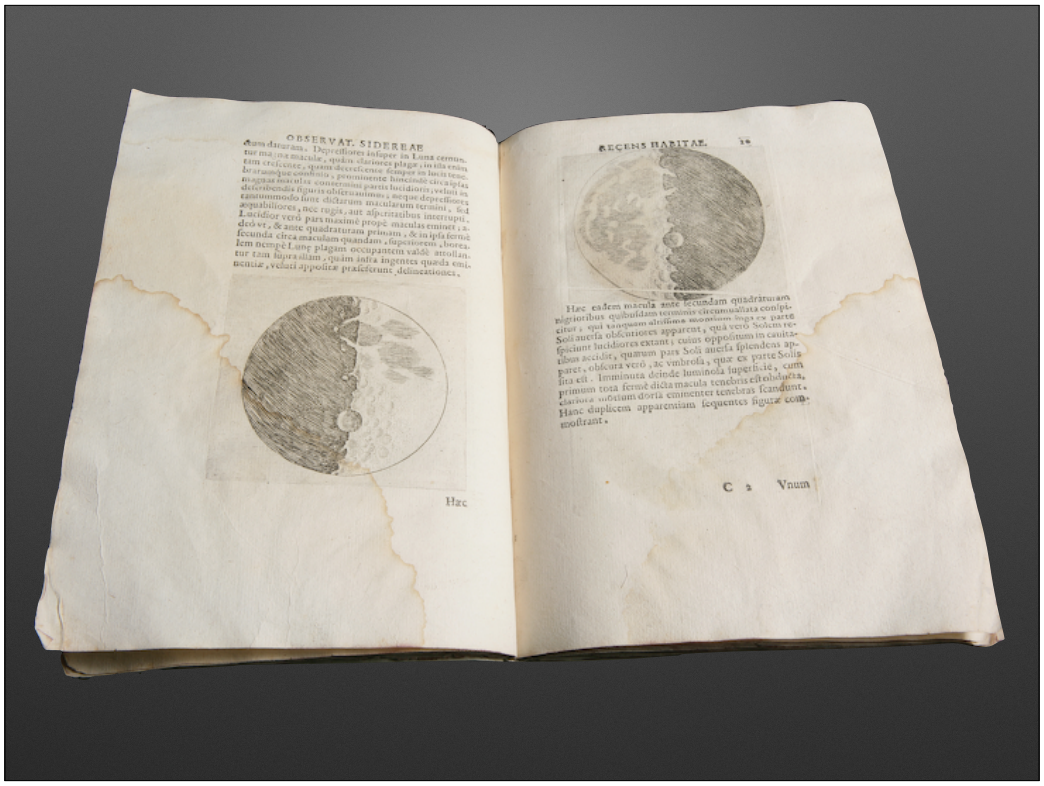
BRENT: Our third goal is to increase the visual impact of oers. Are open textbooks beautiful and compelling, with a high visual impact?



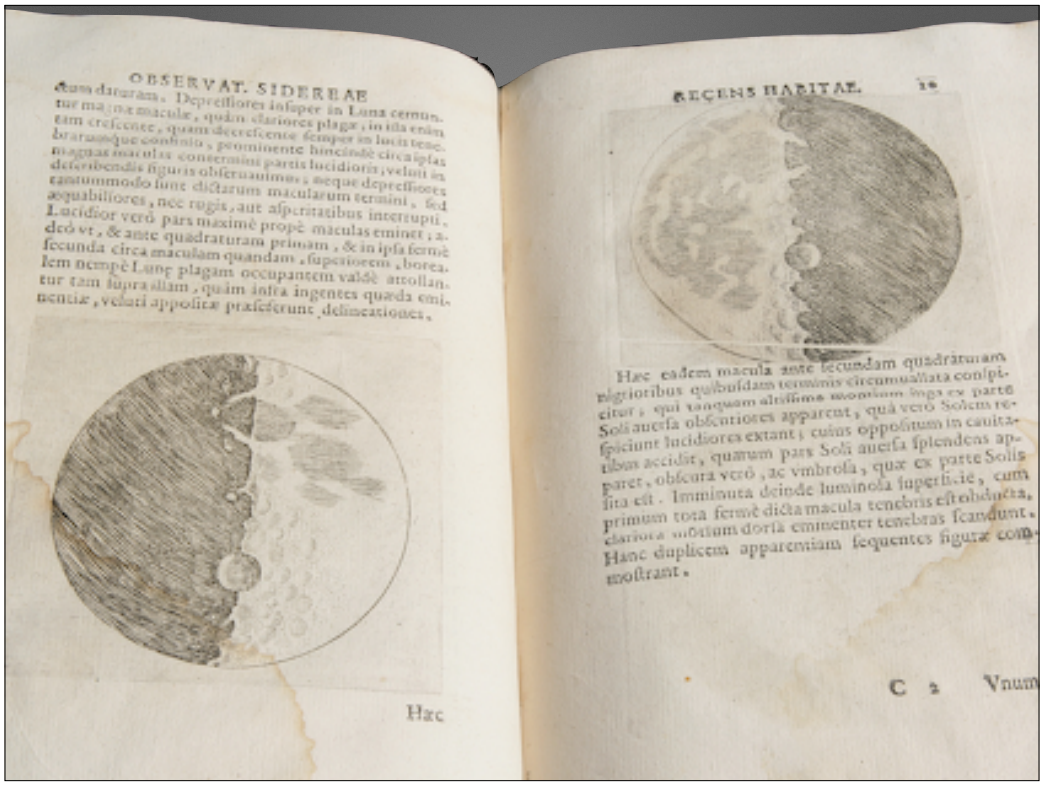
Images are not just *ornamental*. • Often they summarize EVIDENCE presented in visual form. • **Didactic** images help clarify thinking. • And they serve as **icons** of larger meanings. We are not just serving up web-quality images, • but providing high resolution images, wrapped with authorized context.



KERRY: For some examples of images worthy of high resolution, and being wrapped in context, let's look at some connections between astronomy and art.



In 1610, Galileo discovered mountains on the Moon.



OBSERVAT. SIDEREAE

dum duraram. Depressiores insuper in Luna cernuntur magnæ maculæ, quàm clariores plagæ; in illa enim tam crescente, quam decrescente semper in lucis tenebrarumque confinio, prominente hinc inde circa ipsas magnas maculas contermina parte lucidioris, veluti in describendis figuris obseruauimus, æque depressiores tantummodo sunt dictarum macularum termini, sed æquabiliores, nec rugis, aut asperitatibus interrupti. Lucidior verò pars maximè propè maculas eminet; adeò vt, & ante quadraturam primam, & in ipsa fermè secunda circa maculam quandam, superiorem, boream nempè Lunæ plagam occupantem valdè attollantur tam supra illam, quàm infra ingentes quædã eminentiæ, velati appositæ præferunt delineationes.

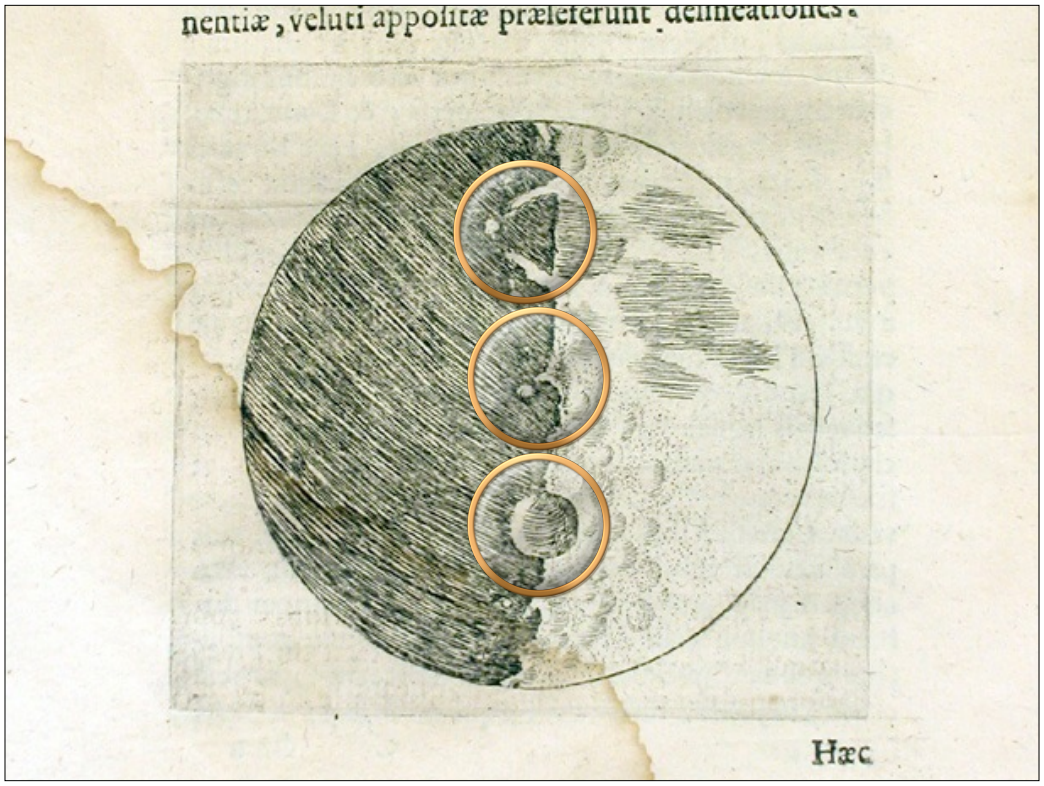
Hæc

SECENS HABITAE.

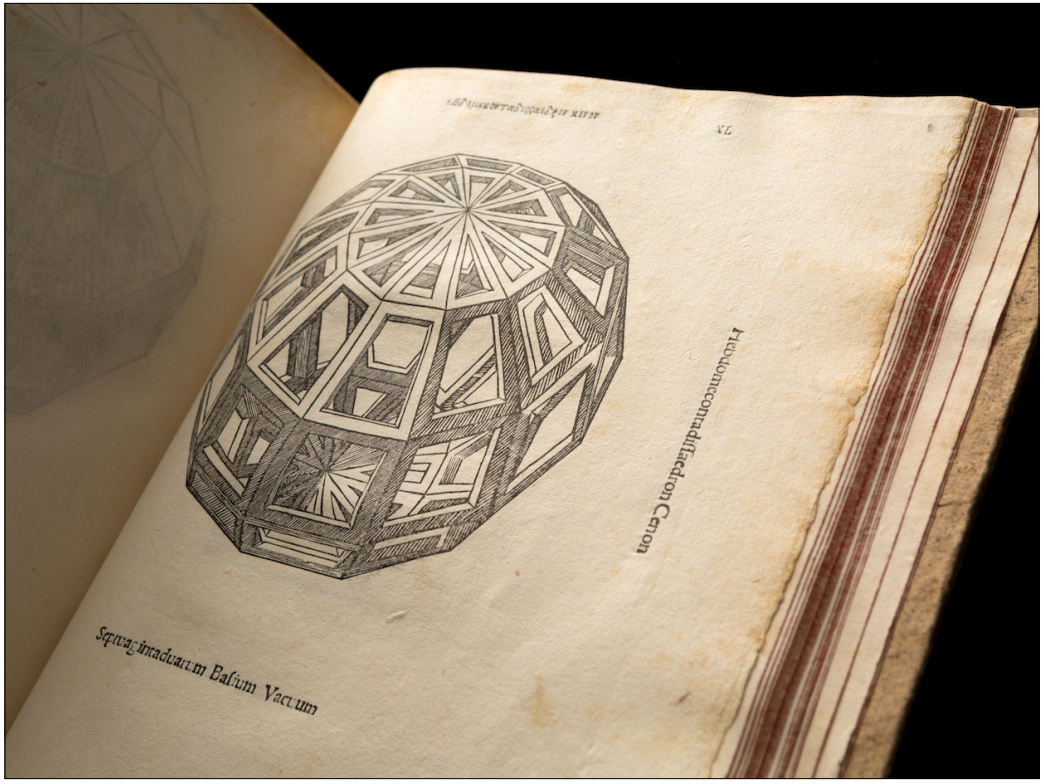
Hæc eadem macula ante secundam quadraturam nigrioribus quibusdam terminis circumuallata conspicitur, qui tanquam altissimi montium iuga ex parte Solis auersa obscuriores apparent, quà verò Solem respiciunt lucidiores extant; cuius oppositum in cauitatibus accidit, quarum pars Solis auersa splendens apparet, obscura verò, ac vmbrosa, quæ ex parte Solis sita est. Imminuta deinde luminosa superficie, cum primum tota fermè dicta macula tenebris est obducta, clariora montium dorsa eminenter tenebras scandunt. Hanc duplicem apparentiam sequentes figuræ commostrant.

C 2 Vnum

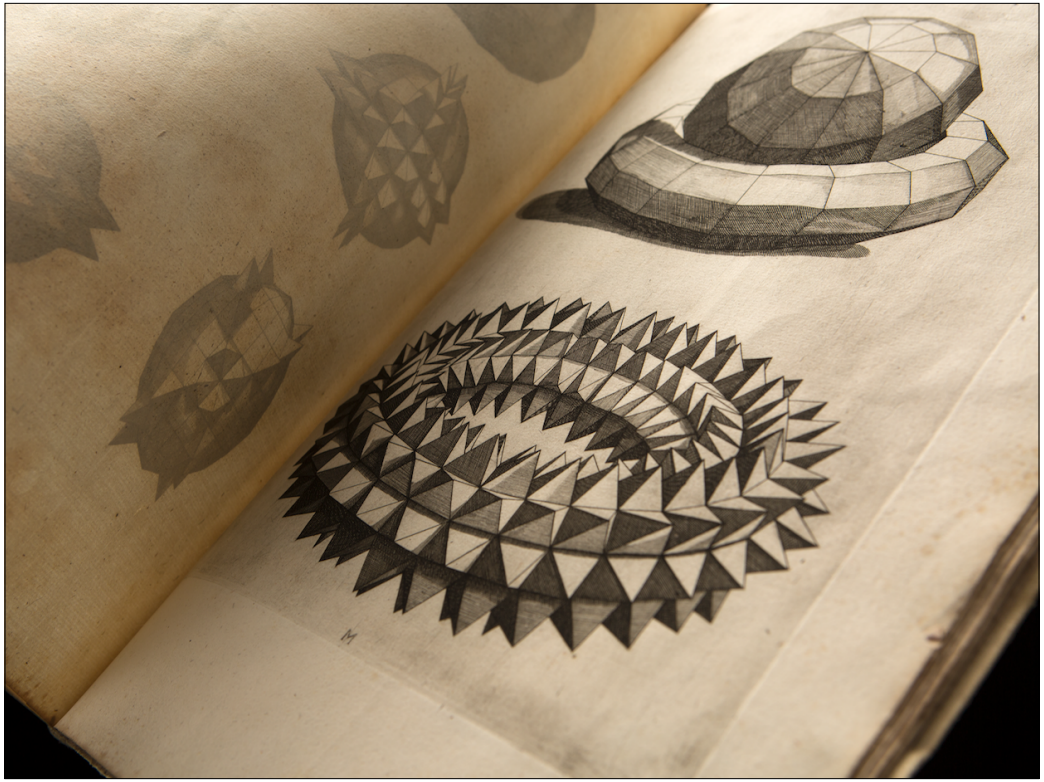
Galileo's discoveries were made not by optics but by the artistic training of his eyes. Galileo's sensational telescopic discoveries would have been impossible were it not for Galileo's training and experience in Renaissance art.



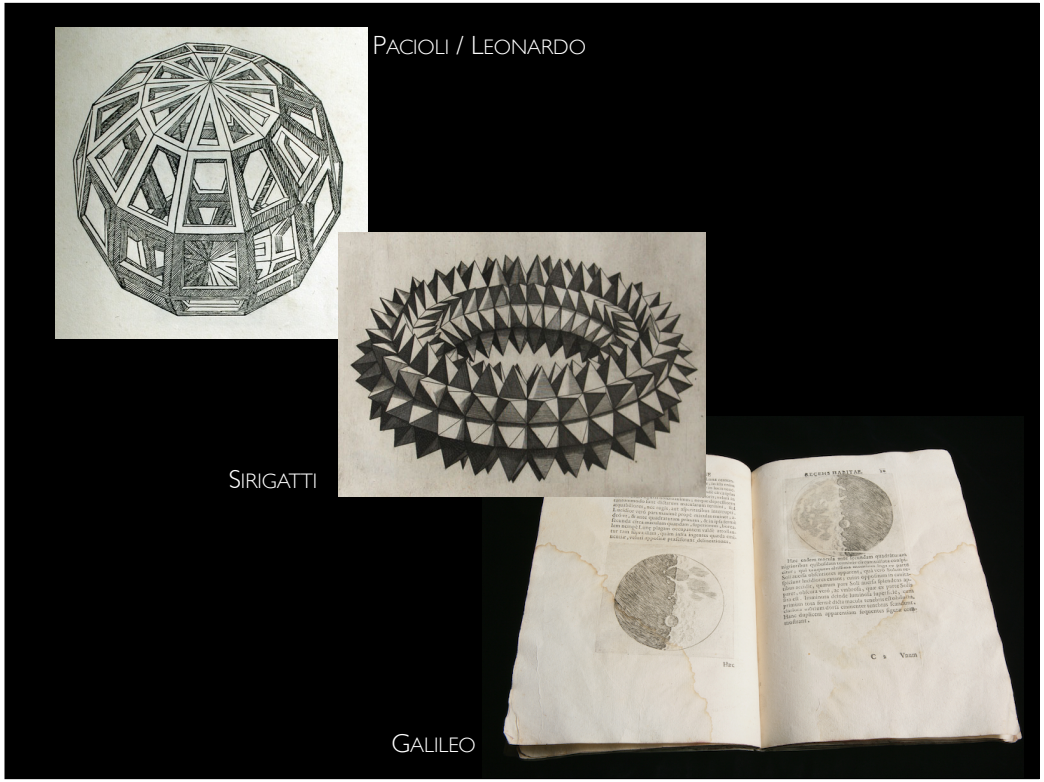
What appears as an isolated peak one night, ❒ may become a chain of mountains the next night, ❒ or converge in a circular structure after that. He was not mapping the moon, or implying that a crater of that size is present in that location, but showing how to detect real lunar topography.



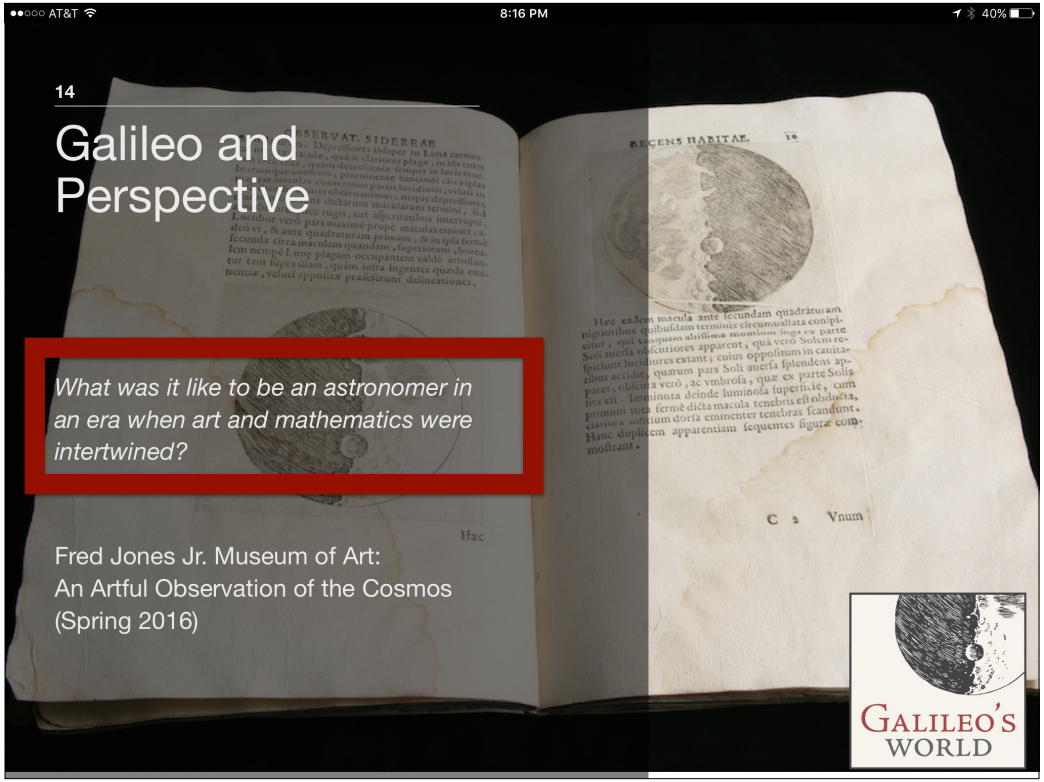
This image demonstrates true perspective and a mastery of light and shadow. This and other similar diagrams were drawn by Leonardo da Vinci. They were the only materials ever published in print by Leonardo during his lifetime. Geometrical figures like these were used to train artists over the following century.



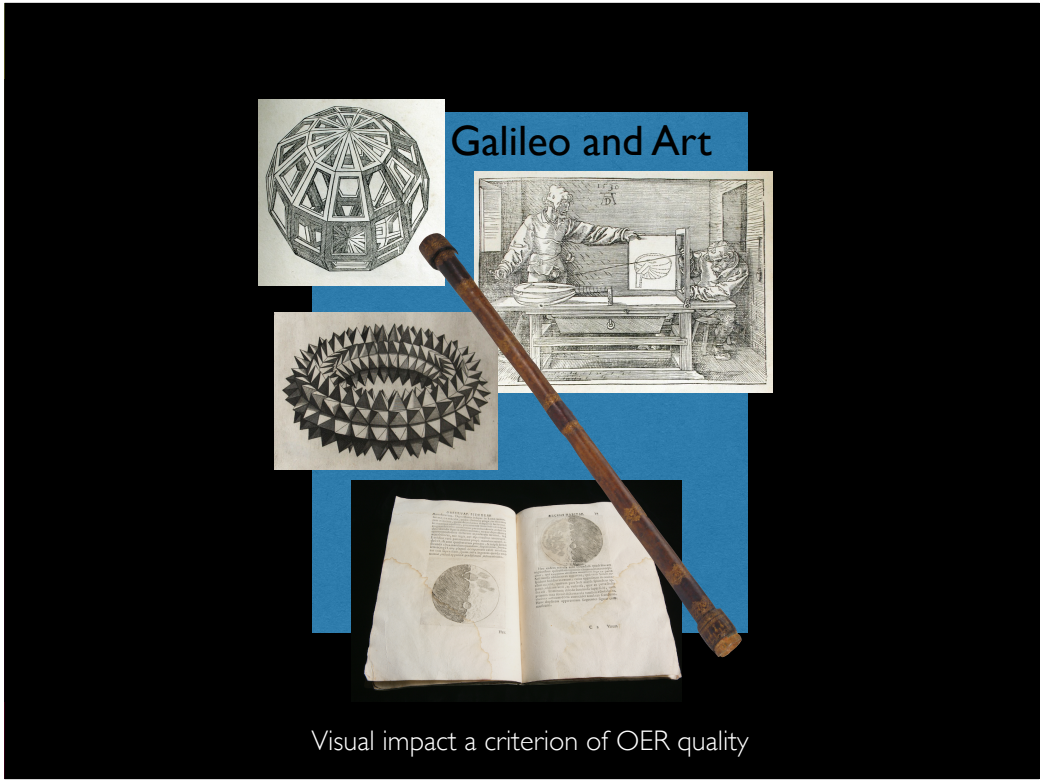
This work on perspective drawing is in the same tradition, published in Venice almost a century later, when Galileo was a young man. Consider the spiked donut at the bottom of the page. Careful study of the spikes on this ring and the shadows they cast prepared Galileo's eyes to interpret what others regarded merely as the "strange spottedness of the Moon" as in fact shadows cast by real mountains.



When Galileo peered through his telescope and discovered the shadows of mountains on the Moon, he did so only because he was seeing with the eyes of an artist. He made his telescopic discoveries as much through art as through optics.



In a gallery this spring at the OU Museum of Art, we will explore “what it was like to be an astronomer” when “art and mathematics were intertwined” in the astronomy of Galileo.



These are some of the images we will provide with stories that put them in context. Images like these were not merely ornamental, but didactic in the way they helped to clarify thought. Scientists often think visually, beyond the reach of text alone. The close relationship of science and art makes it crucial to consider visual impact as one criterion in any study of OER quality, particularly in the sciences where spatial reasoning is prominent and 3-D instruments and operations are frequent.

This story also illustrates our 2d goal, the multidisciplinary character of history of science. Students in astronomy and art have much to talk about.

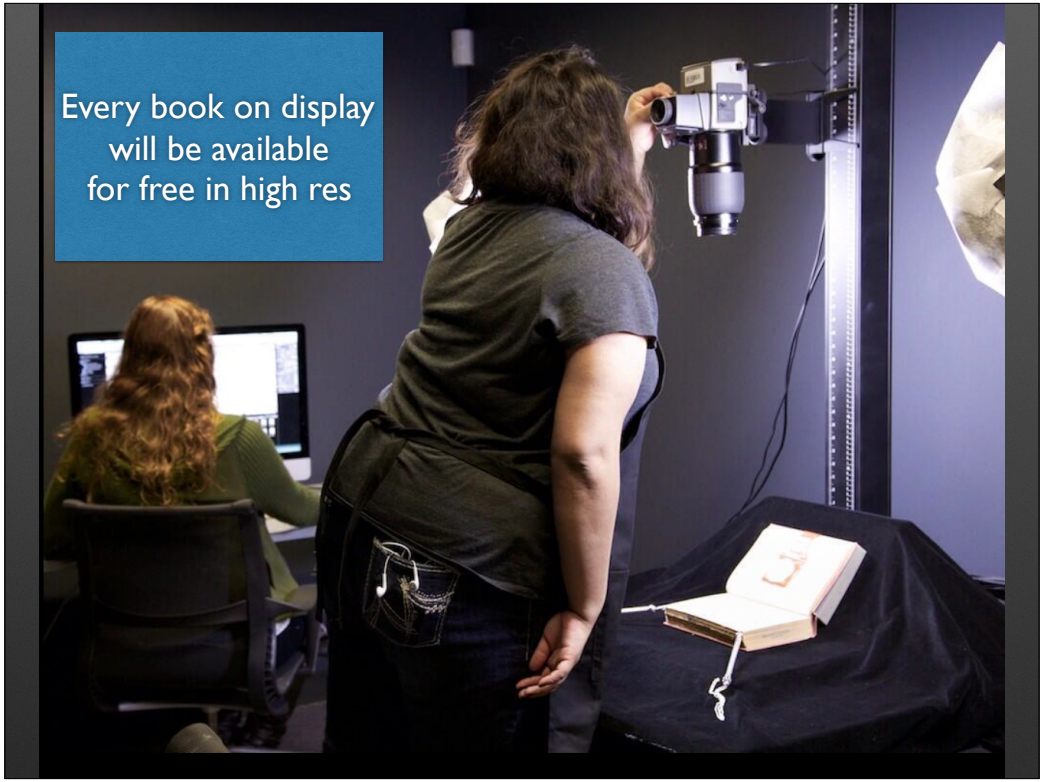
BRENT: So our three goals are to model an OER role for special collections, to increase awareness of the multidisciplinary potential of OERs in the history of science, and to increase the visual impact of OERs. These are specific and distinctive goals in which we think a local effort may have wide-ranging impact.

Our first strategy depends on the library as an intellectual commons for the University.

University Collaborators

- Academic programs: History of Science Department, Education, Engineering, Sciences, Humanities…
- Center for Teaching Excellence – Adam Croom
- K20 Center
- Athletics, Natural History Museum, Art Museum
- OU Libraries
  - History of Science Collections
  - DigiLab

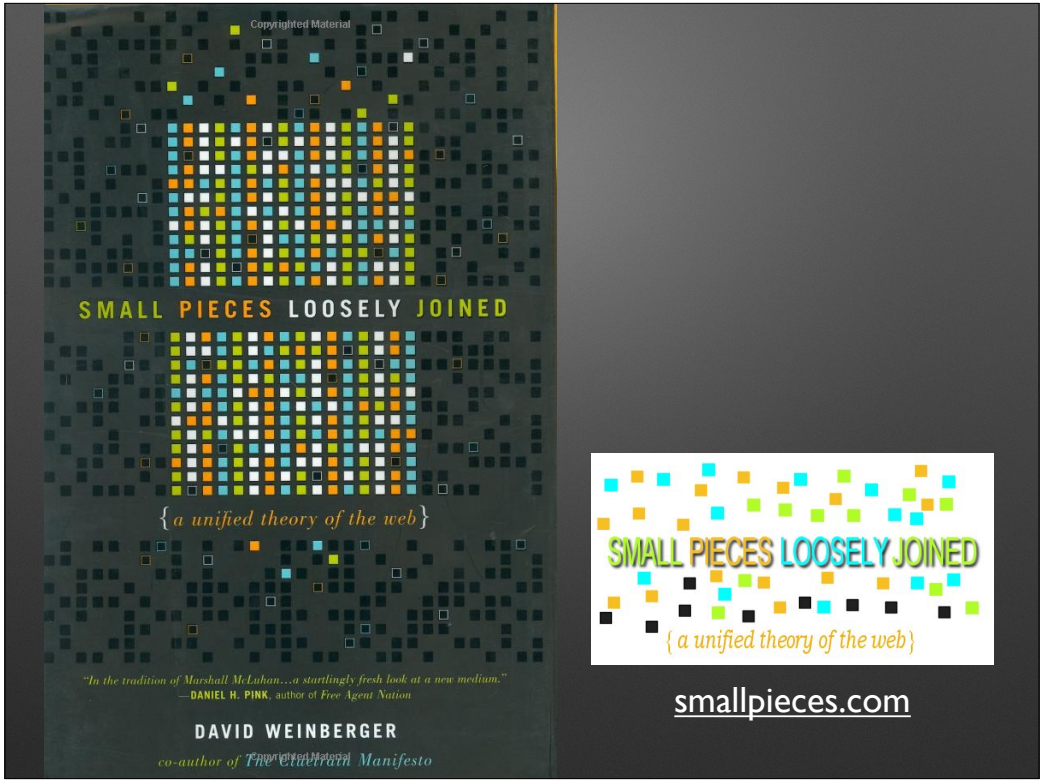
Special collections are at the crossroads of academic departments. We are collaborating with partners across the university. Within the University Libraries, the GW exhibit has served as a focus for the entire library organization to retool itself toward the end of making Open Access resources.



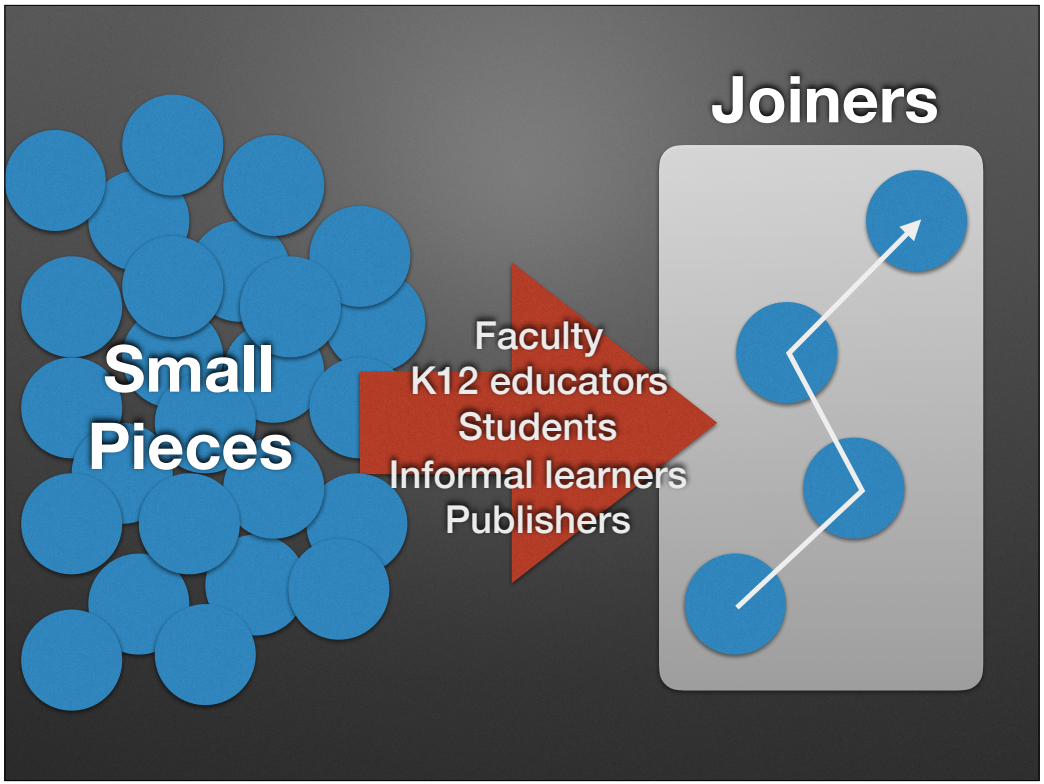
Every book will be available in its entirety online, each page in high resolution files for free download.

The Repository is being built on the Islandora platform and will support analytics, version control, and a • new peer-reviewed academic publishing effort called Edition Open Sources. The Digital library will launch this spring.

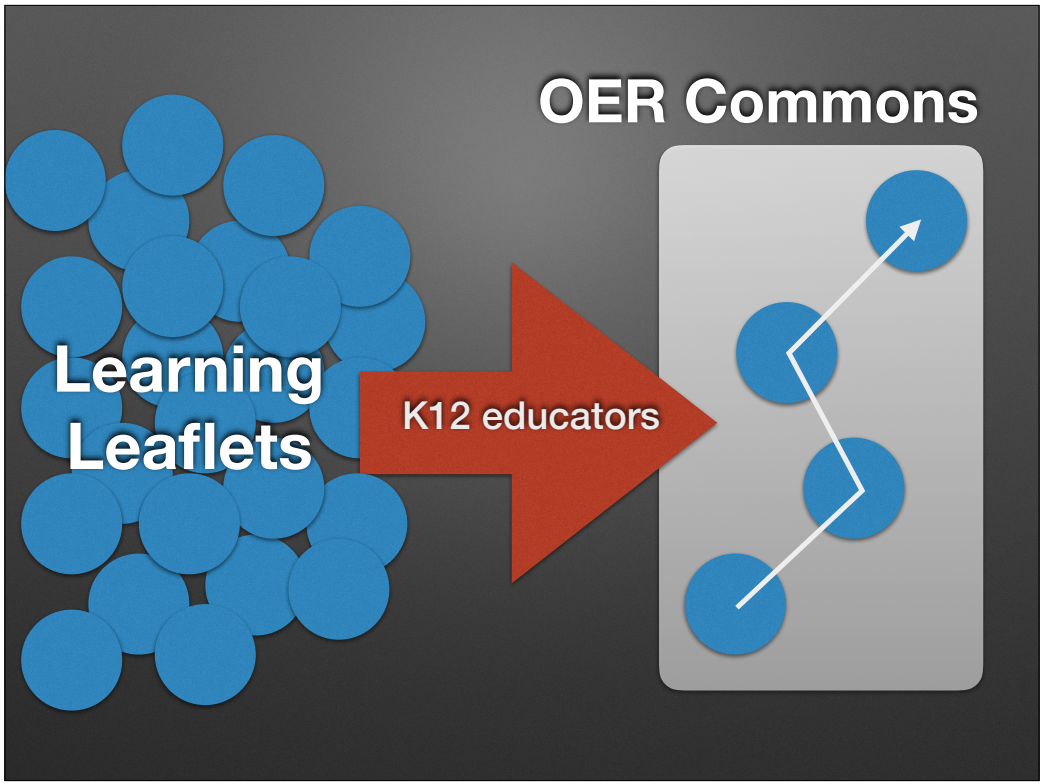
The second aspect of our strategy is inspired by the theory of the web as “Small pieces loosely joined.”



Back in 2002, David Weinberger famously defined the essential character of the web as small pieces loosely joined. This characterization aptly describes learning objects, both physical and virtual. We are not aiming to create full textbooks, not even in the history of science! Rather, we are focusing on smaller chunks which may be used in wide-ranging and unexpected ways.

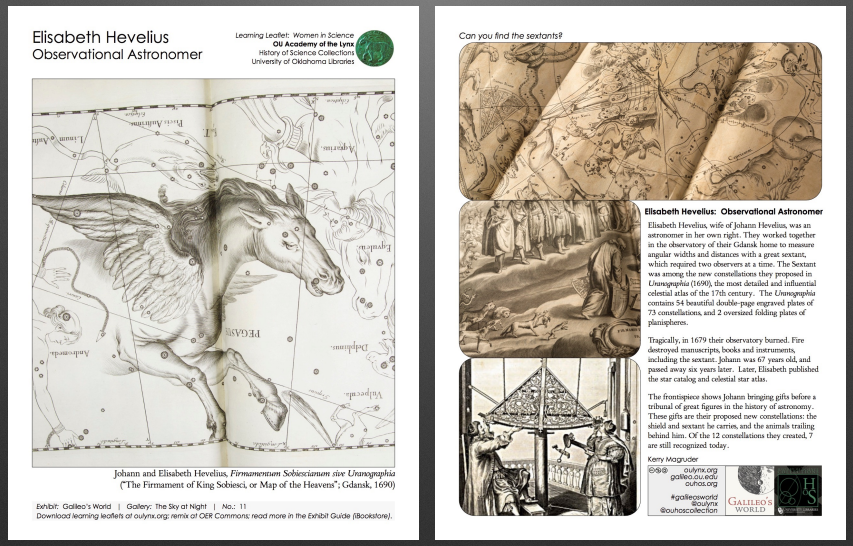


In special collections, we, our faculty, and our students, create Small Pieces. • Then, Joiners will construct meaning by connecting the dots according to their own context and interests. • The joiners may be Faculty, K12 teachers, students in classes, informal adult learners, or even publishers.

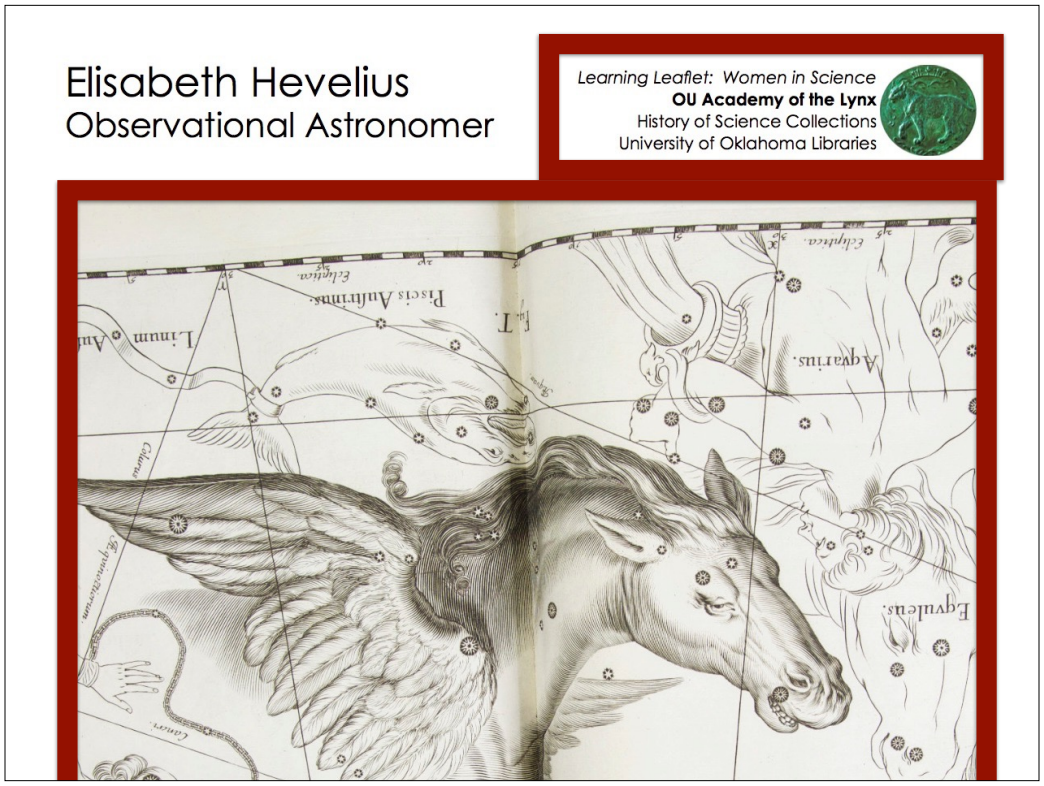


Our small pieces are learning leaflets. We'll collaborate with K12 educators to join them together at OER Commons.

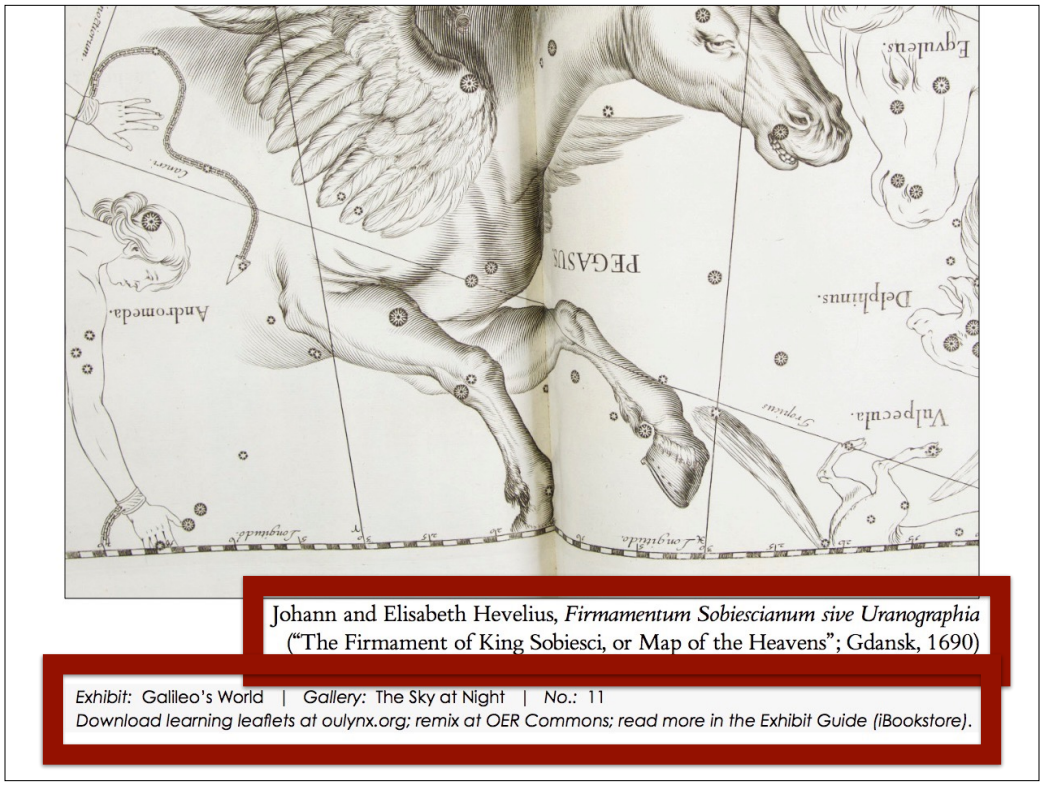
Learning Leaflets



Learning Leaflets are brief learning activities, designed to be useful in a variety of teaching situations. They are “Small Pieces,” adaptable to support lessons in multiple subject areas and age levels.



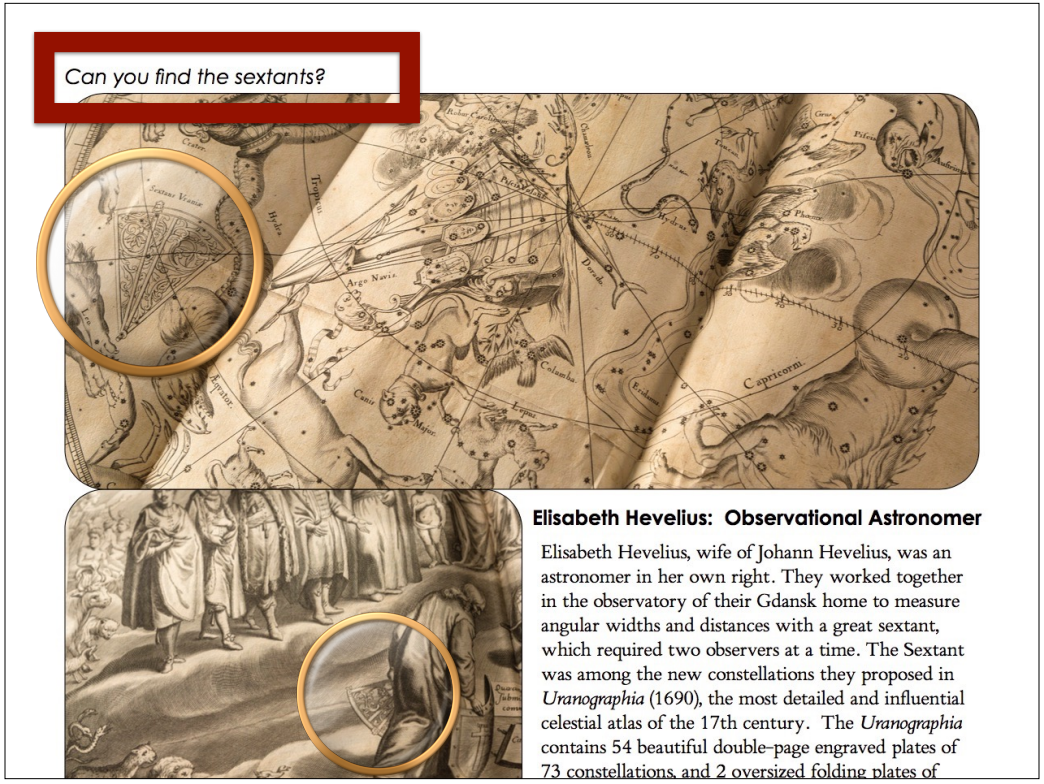
This learning leaflet is from a series called Women in Science. • Every learning leaflet features a main image to prompt reflection and discussion.



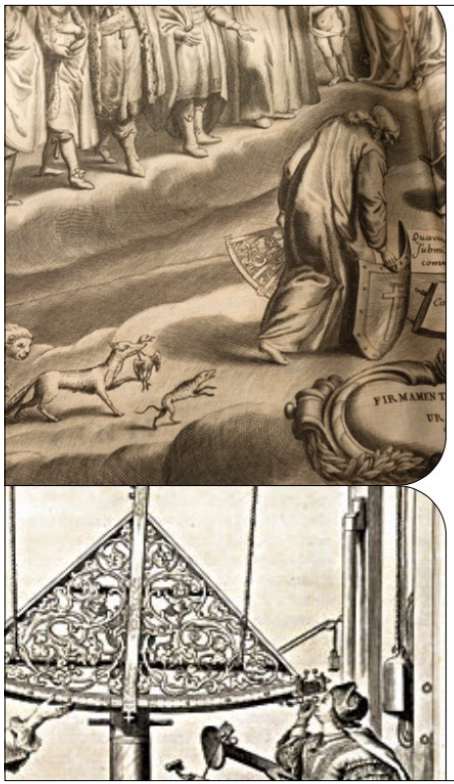
Johann and Elisabeth Hevelius, *Firmamentum Sobiescianum sive Uranographia* ("The Firmament of King Sobiesci, or Map of the Heavens"; Gdansk, 1690)

Exhibit: Galileo's World | *Gallery:* The Sky at Night | *No.:* 11
Download learning leaflets at oulynx.org; remix at OER Commons; read more in the Exhibit Guide (iBookstore).

Beneath the main image is a caption • and an indication of one or more exhibit objects in the exhibit related to the leaflet.



The back side usually has a question for discussion: (read)



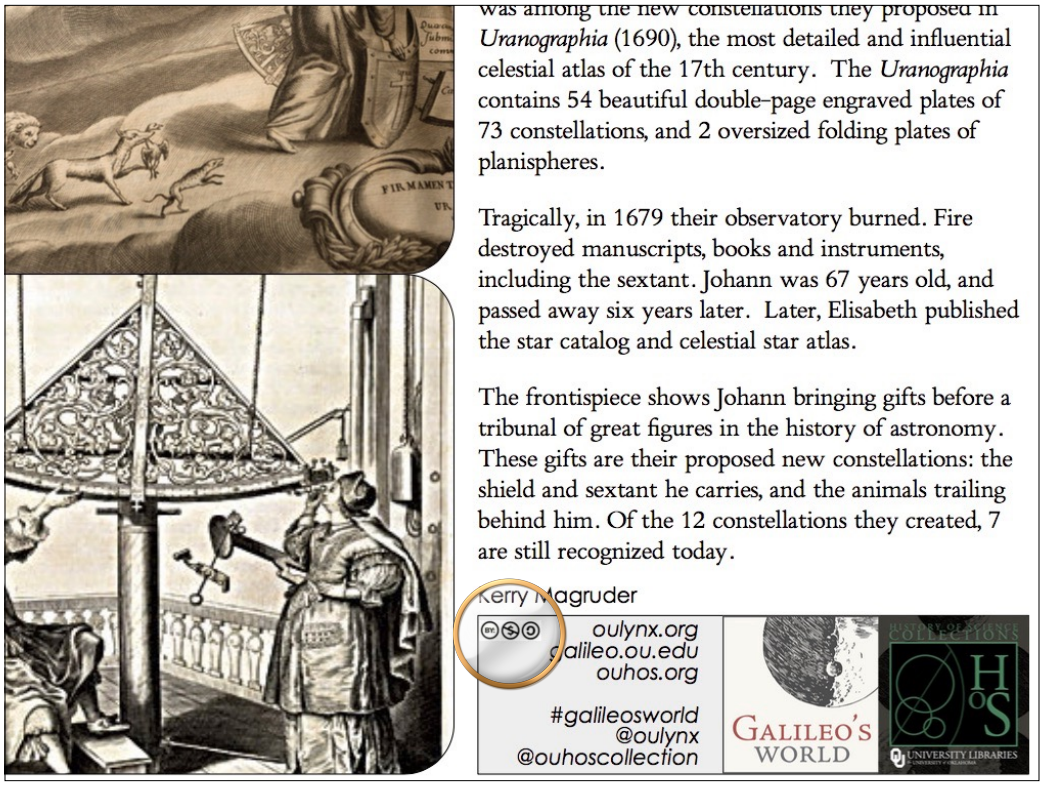
Elisabeth Hevelius: Observational Astronomer

Elisabeth Hevelius, wife of Johann Hevelius, was an astronomer in her own right. They worked together in the observatory of their Gdansk home to measure angular widths and distances with a great sextant, which required two observers at a time. The Sextant was among the new constellations they proposed in *Uranographia* (1690), the most detailed and influential celestial atlas of the 17th century. The *Uranographia* contains 54 beautiful double-page engraved plates of 73 constellations, and 2 oversized folding plates of planispheres.

Tragically, in 1679 their observatory burned. Fire destroyed manuscripts, books and instruments, including the sextant. Johann was 67 years old, and passed away six years later. Later, Elisabeth published the star catalog and celestial star atlas.

The frontispiece shows Johann bringing gifts before a tribunal of great figures in the history of astronomy. These gifts are their proposed new constellations: the shield and sextant he carries, and the animals trailing behind him. Of the 12 constellations they created, 7 are still recognized today.

The text tells an interesting story related to the images. In the case of the most influential star atlas of the 17th century, the person responsible for *much* of the content, and *solely* for its publication, was a woman, Elisabeth Hevelius.

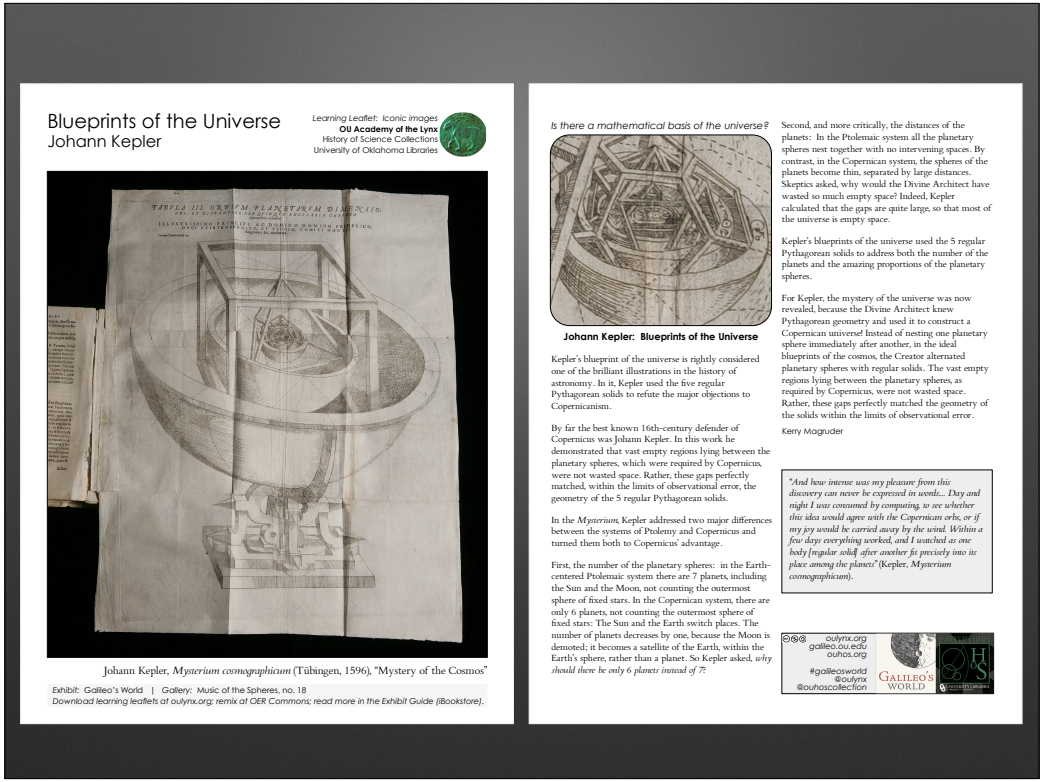


At the bottom, we have the CC license indicating permission to share it. As a result of conversations here at OpenEd, we are now thinking we'll drop the non-commercial restriction and just go with either cc-by or cc-share alike. The same content will be posted to the blog, the repository and OER Commons, both text and the image files.

Series

- Iconic Images

Other series we're working on right now are "Iconic images"



Blueprints of the Universe
Johann Kepler

Learning Leaflet: Iconic Images
OU Academy of the Lynx
History of Science Collections
University of Oklahoma Libraries

Johann Kepler, *Mysterium cosmographicum* (Tübingen, 1596), "Mystery of the Cosmos"

Exhibit: Galileo's World | Gallery: Music of the Spheres, no. 18
Download learning leaflets at oulynx.org; remix at OER Commons; read more in the Exhibit Guide (iBookstore).

Is there a mathematical basis of the universe?

Johann Kepler: Blueprints of the Universe

Kepler's blueprint of the universe is rightly considered one of the brilliant illustrations in the history of astronomy. In it, Kepler used the five regular Pythagorean solids to refute the major objections to Copernicanism.

By far the best known 16th-century defender of Copernicus was Johann Kepler. In this work he demonstrated that vast empty regions lying between the planetary spheres, which were required by Copernicus, were not wasted space. Rather, these gaps perfectly matched, within the limits of observational error, the geometry of the 5 regular Pythagorean solids.

In the *Mysterium*, Kepler addressed two major differences between the systems of Ptolemy and Copernicus and turned them both to Copernicus' advantage.

First, the number of the planetary spheres: in the Earth-centered Ptolemaic system there are 7 planets, including the Sun and the Moon, not counting the outermost sphere of fixed stars. In the Copernican system, there are only 6 planets, not counting the outermost sphere of fixed stars: The Sun and the Earth switch places. The number of planets decreases by one, because the Moon is demoted; it becomes a satellite of the Earth, within the Earth's sphere, rather than a planet. So Kepler asked, *why should there be only 6 planets instead of 7?*

Second, and more critically, the distances of the planets: In the Ptolemaic system all the planetary spheres nest together with no intervening spaces. By contrast, in the Copernican system, the spheres of the planets become thin, separated by large distances. Skeptics asked, why would the Divine Architect have wasted so much empty space? Indeed, Kepler calculated that the gaps are quite large, so that most of the universe is empty space.

Kepler's blueprints of the universe used the 5 regular Pythagorean solids to address both the number of the planets and the amazing proportions of the planetary spheres.

For Kepler, the mystery of the universe was now revealed, because the Divine Architect knew Pythagorean geometry and used it to construct a Copernican universe! Instead of nesting one planetary sphere immediately after another, in the ideal blueprints of the cosmos, the Creator alternated planetary spheres with regular solids. The vast empty regions lying between the planetary spheres, as required by Copernicus, were not wasted space. Rather, these gaps perfectly matched the geometry of the solids within the limits of observational error.

Kerry Magruder

"And how intense was my pleasure from this discovery can never be expressed in words... Day and night I was consumed by computing, to see whether this idea would agree with the Copernican orbs, or if my joy would be carried away by the wind. Within a few days everything worked, and I watched as one body [regular solid] after another fit precisely into its place among the planets" (Kepler, *Mysterium cosmographicum*).

oulynx.org
galileo.ou.edu
ouhos.org

#galileosworld
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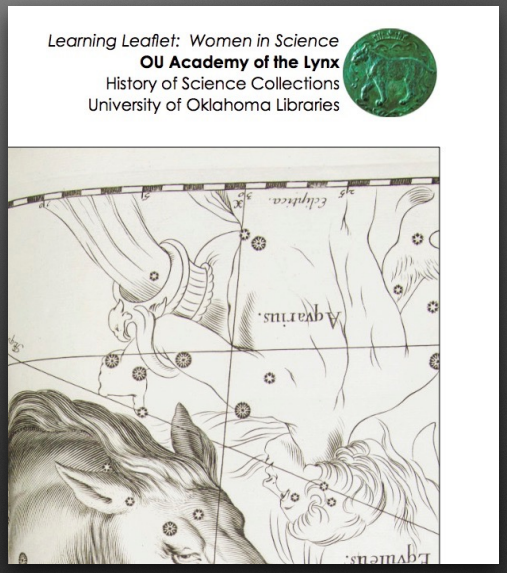
@ouhoscollection

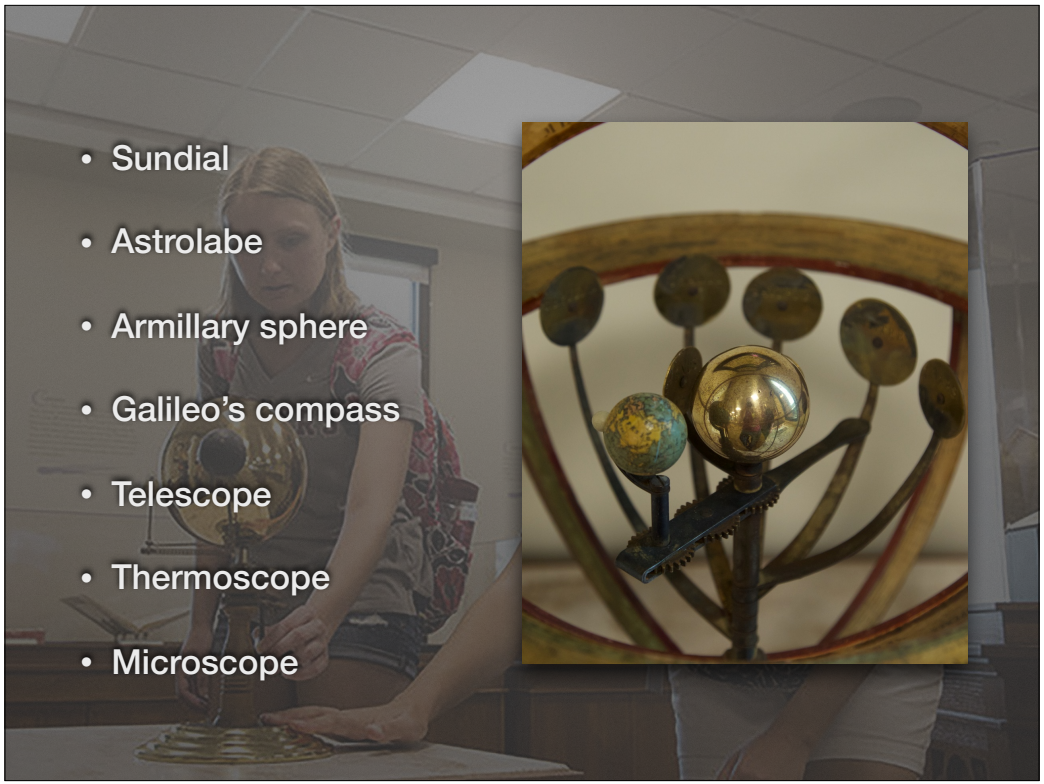
This one describes how Kepler used the Platonic solids to prove Copernicus, constructing the blueprints of the universe, in his first book published in 1596.

Series

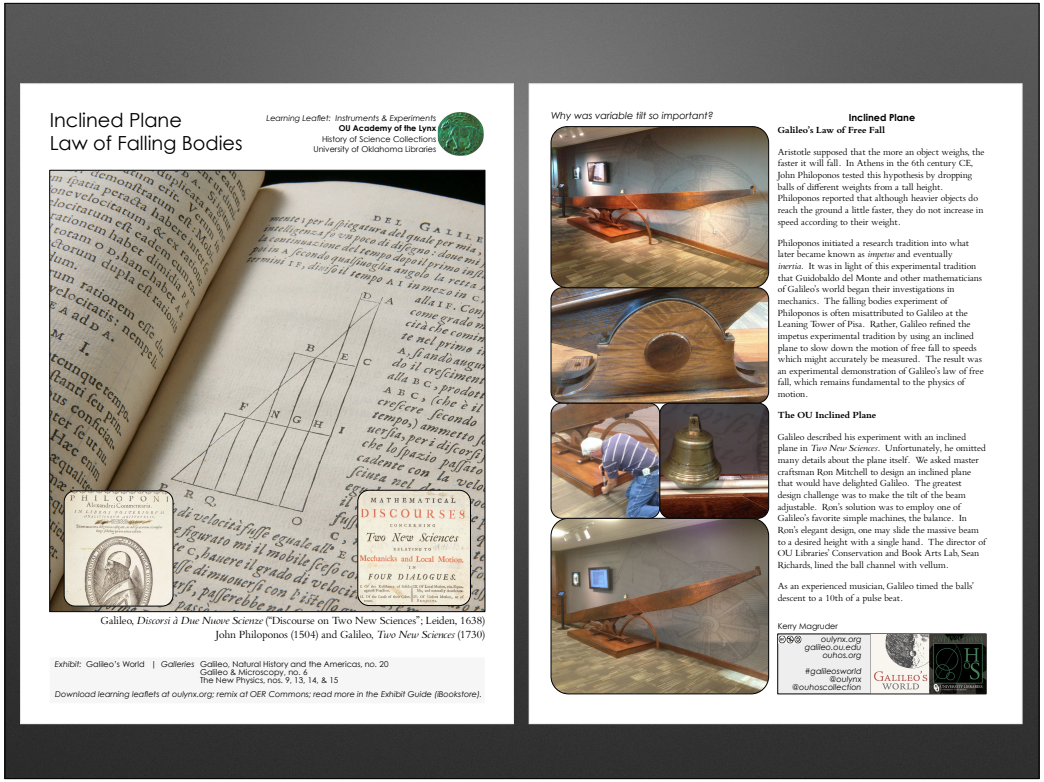
- Iconic Images
- Instruments and Experiments



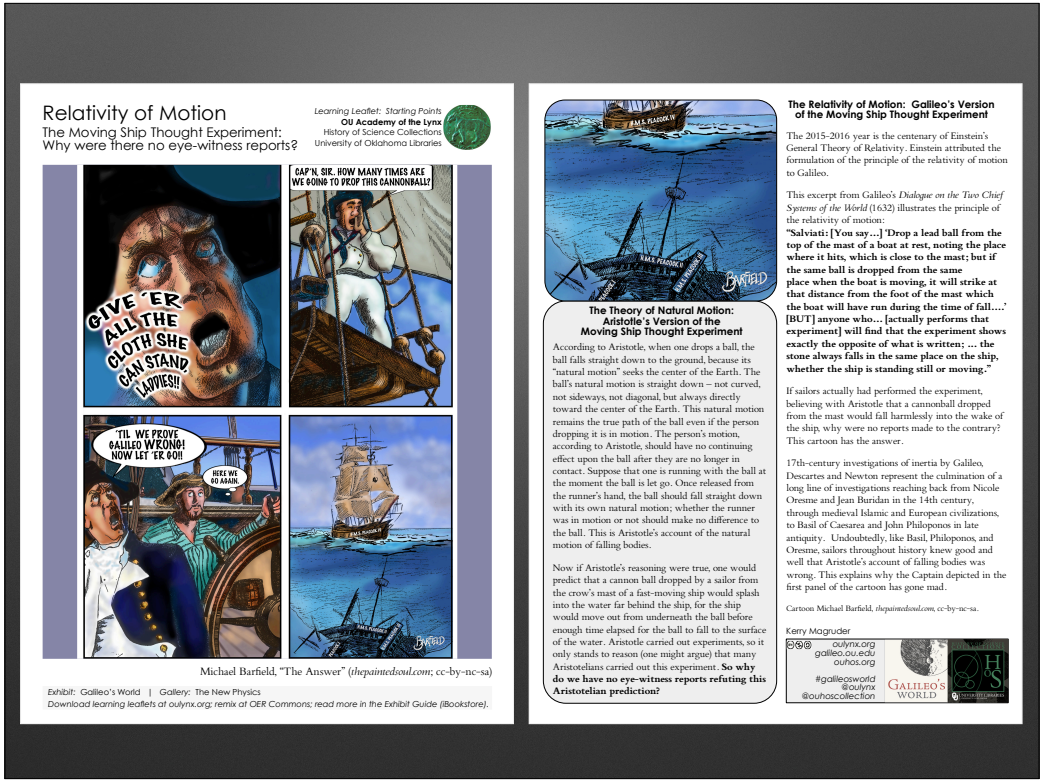
Another series is on classic instruments and experiments.



Leaflets for these instruments are in preparation. Images can help us move beyond the printed page, into the student’s physical world, with replicas and even 3D models.



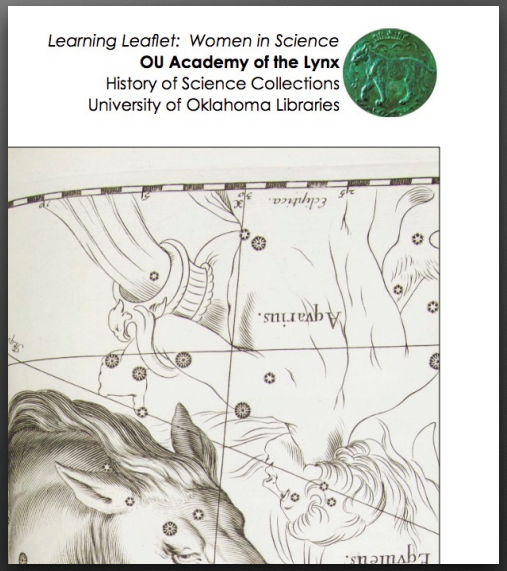
Here's a leaflet about Galileo's law of free fall and his inclined plane experiment, which also describes the design of our reconstruction of Galileo's inclined plane.



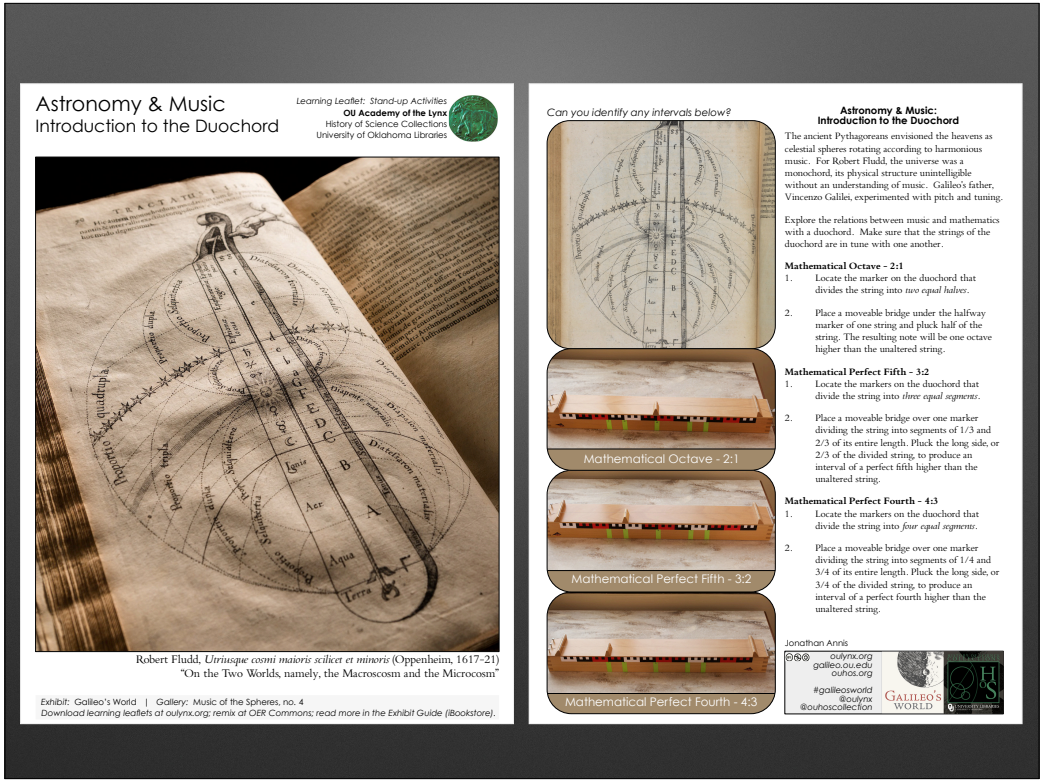
Not all of our images are from rare books; this one features a cartoon for physics classes we are making available cc-by. The cartoon explains a thought experiment in which a cannon ball is dropped from the mast of a moving ship. According to Aristotle, the cannonball would land safely in the wake behind the ship. The cartoon explains why there were no reports that Aristotle's theory was wrong — if Galileo was right, the cannonball would sink the ship.

Series

- Iconic Images
- Instruments and Experiments
- Starting Points for discussion
- Primary Source excerpts
- 2-minute stories
- Stand-up activities
- Constellations
- Women in Science

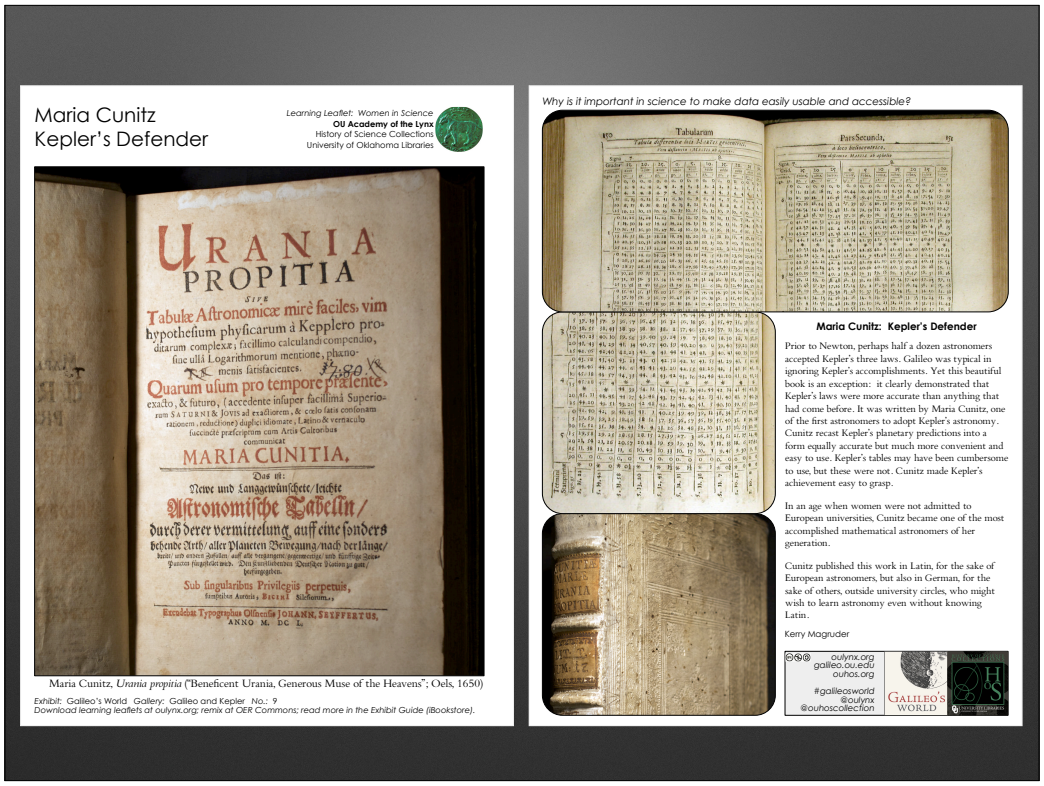


The cartoon is in the Starting Points series; there are also primary source excerpts and 2-minute stories, among others. Anyone may print these leaflets off for classes, remix and revise the content, include them in course packets, and use them in making their own OERs.



This leaflet shows Fludd's depiction of the universe as a monochord on the front, and leads you through the activity with the monochord on the back.

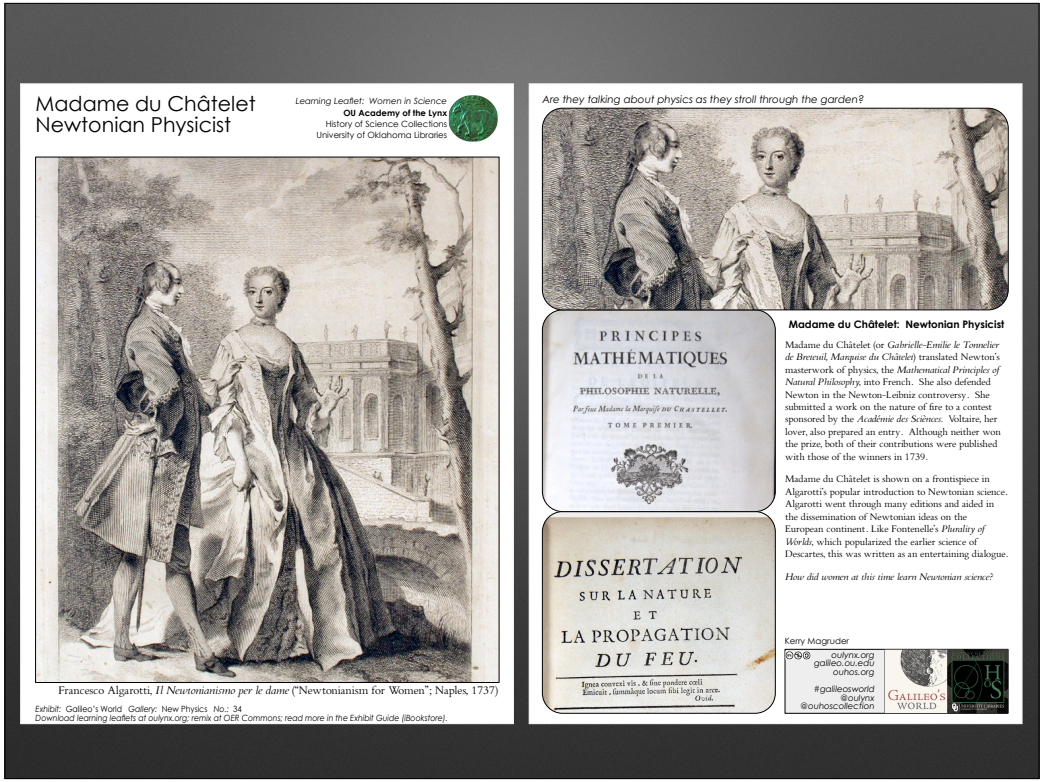
This leaflet introduces the properties of the 5 regular Pythagorean solids.



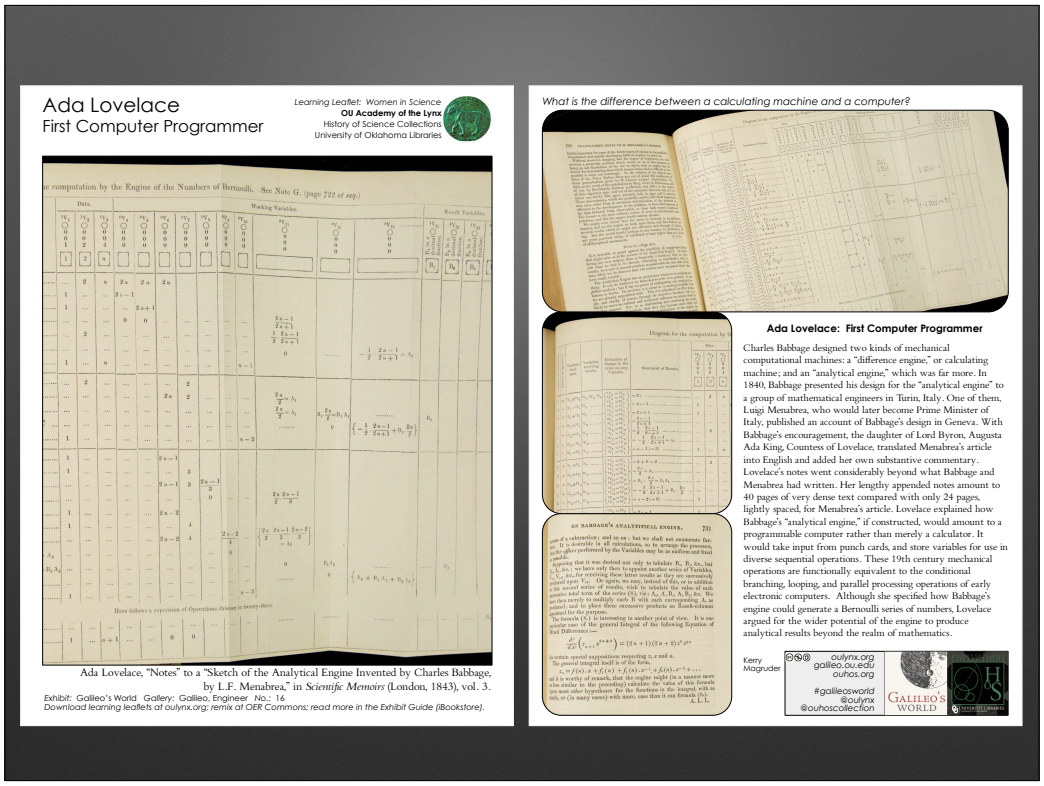
Maria Cunitz, *Urania propitia* ("Beneficent Urania, Generous Muse of the Heavens"; Oels, 1650)

Exhibit: Galileo's World *Gallery:* Galileo and Kepler *No.:* 9
Download learning leaflets at oulynx.org; remix at OER Commons; read more in the Exhibit Guide (iBookstore).

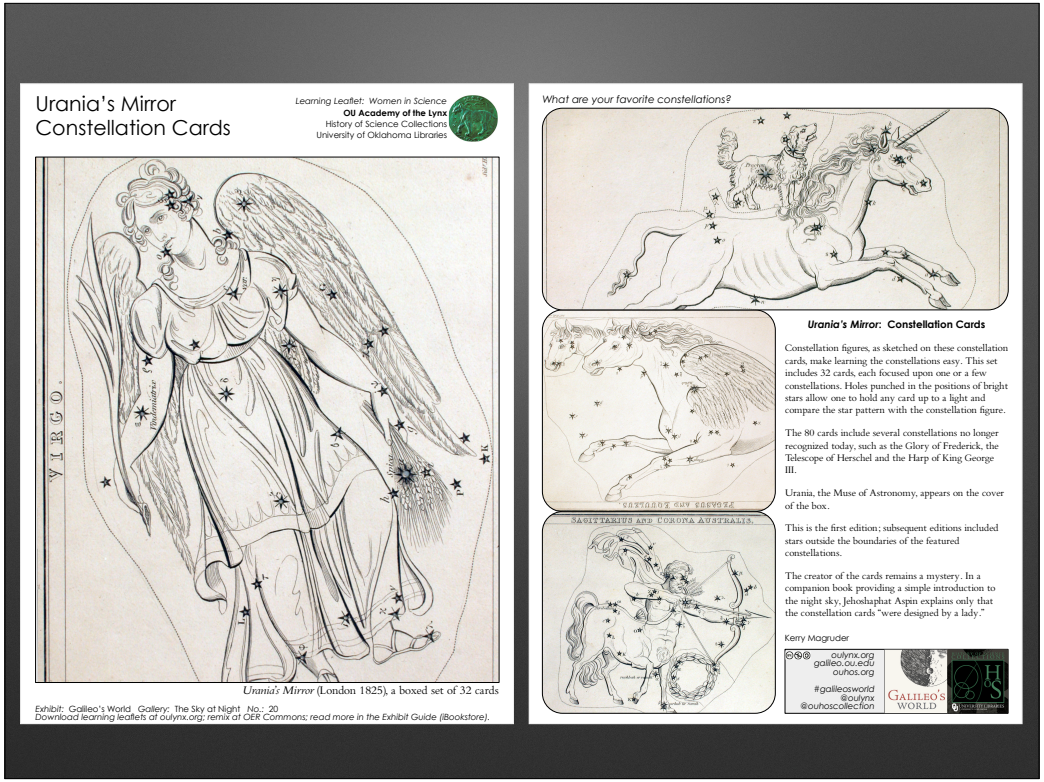
This is the book which made clear to many, including Newton, that Kepler's laws are correct. It was written by a woman, Maria Cunitz.



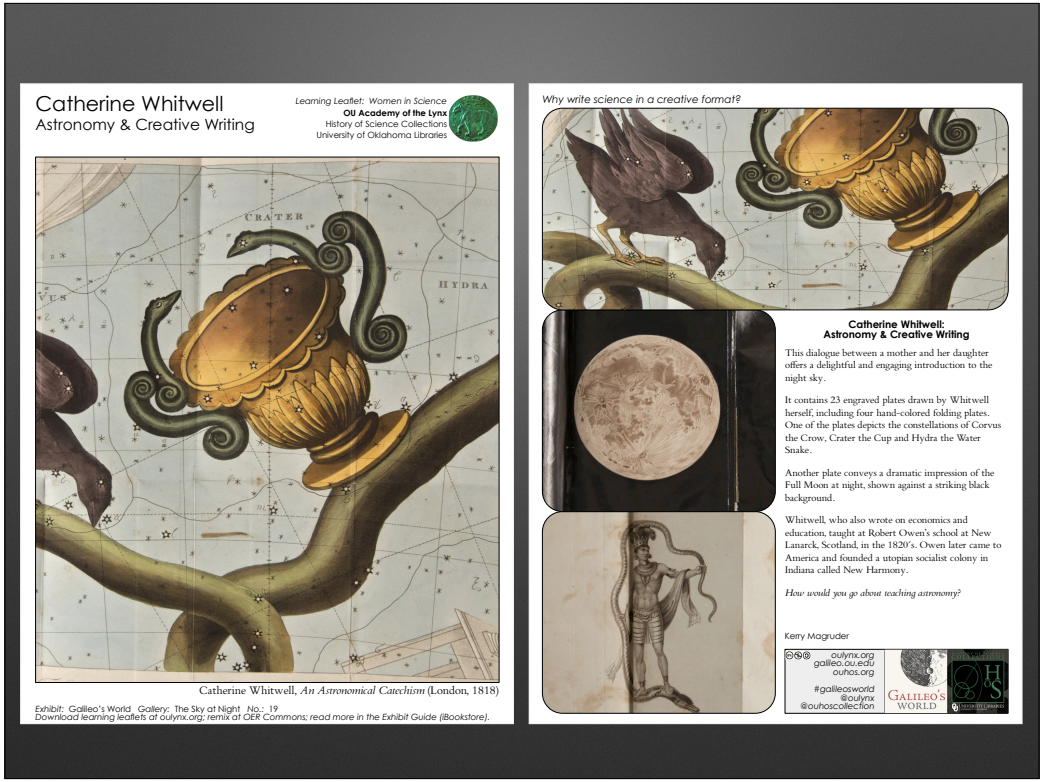
Madame du Chatelet translated Newton's Principia into French, and popularized the idea that women should be taught science in order to discuss Newtonian physics while strolling in the garden.



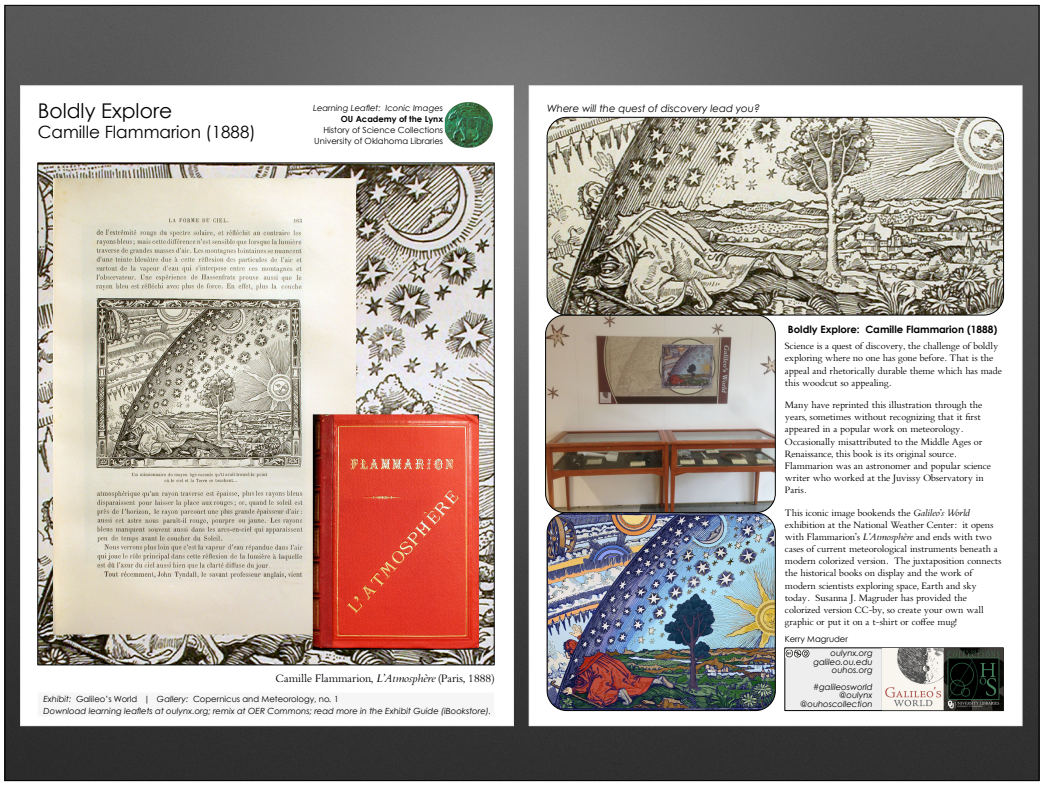
Here's one about Ada Lovelace, who wrote the first computer program, before the computer existed



This one introduces the constellation cards in a boxed set from 1825

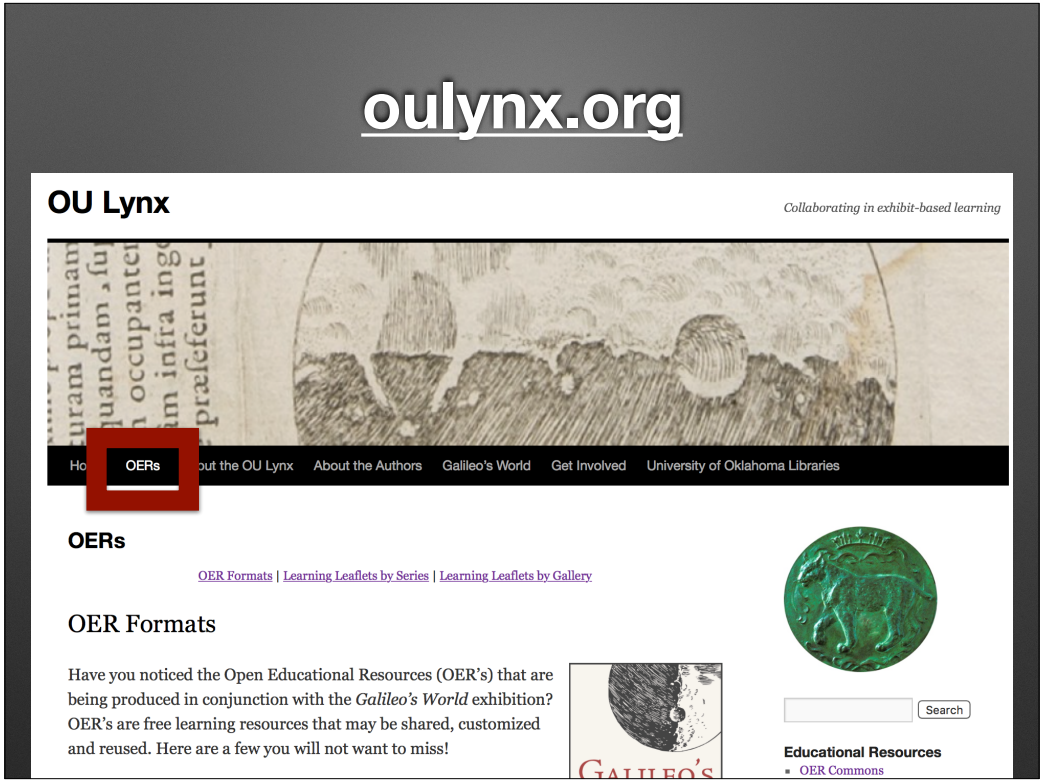


Catherine Whitwell combined astronomy and creative writing, using an innovative pedagogy, for a Scottish school in the early 19th century

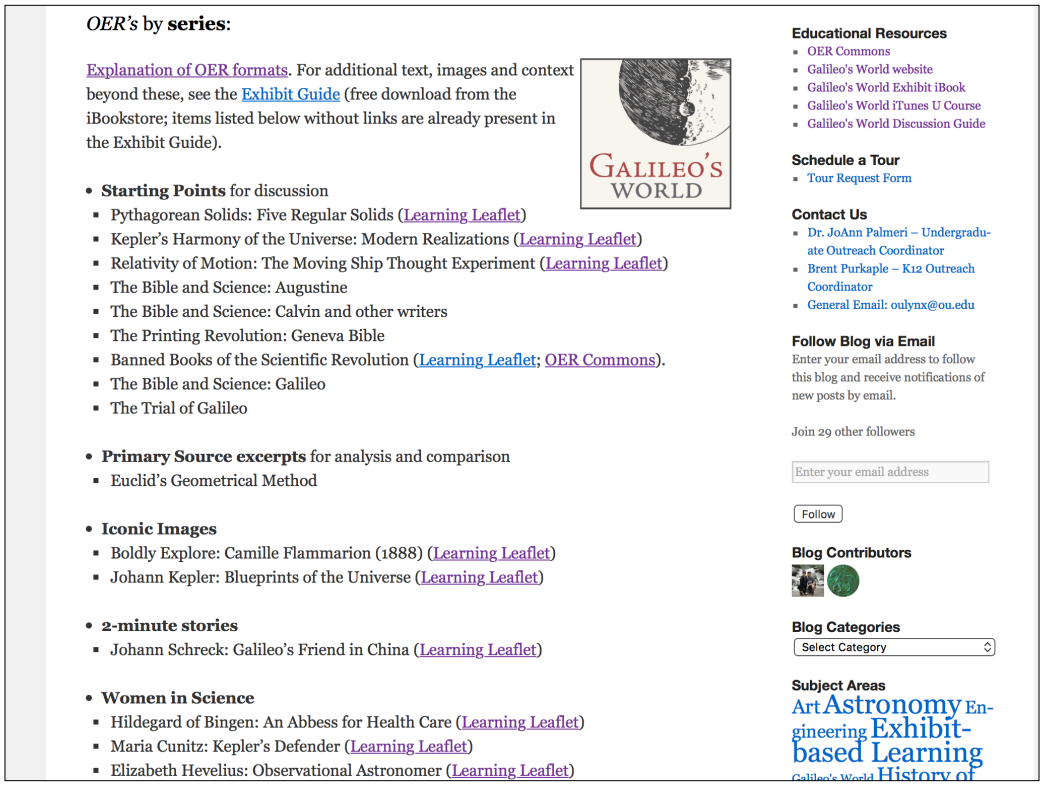


And this one in the iconic images series describes the source of a famous image that conveys the excitement of science as a quest to boldly explore where no one has gone before.

The OU Academy of the Lynx is our new umbrella organization for collaborating in exhibit-based learning.



Until the Digital library launches, find learning leaflets on the oulynx blog. • Click on the OER link at the top. At present, they exist as pdfs, to print front and back. Once the repository launches in the spring semester, the pdfs will be hosted there, organized and tagged.

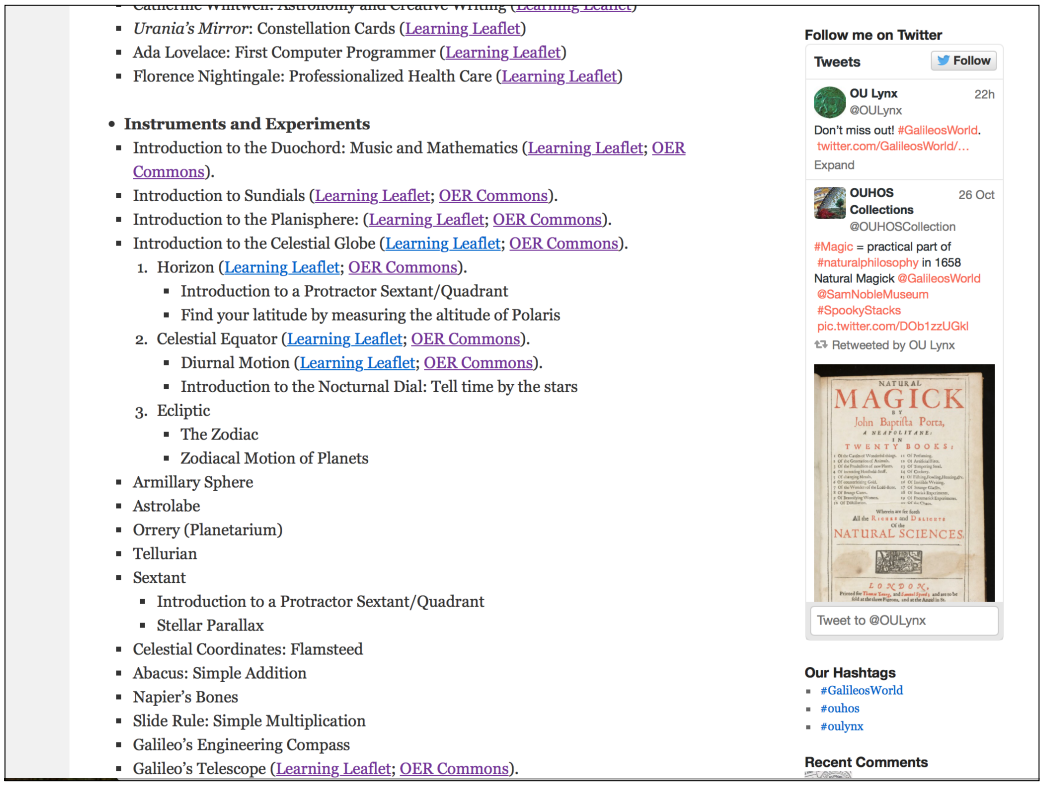


OER's by **series**:

Explanation of OER formats. For additional text, images and context beyond these, see the Exhibit Guide (free download from the iBookstore; items listed below without links are already present in the Exhibit Guide).

- **Starting Points** for discussion
  - Pythagorean Solids: Five Regular Solids (Learning Leaflet)
  - Kepler's Harmony of the Universe: Modern Realizations (Learning Leaflet)
  - Relativity of Motion: The Moving Ship Thought Experiment (Learning Leaflet)
  - The Bible and Science: Augustine
  - The Bible and Science: Calvin and other writers
  - The Printing Revolution: Geneva Bible
  - Banned Books of the Scientific Revolution (Learning Leaflet; OER Commons).
  - The Bible and Science: Galileo
  - The Trial of Galileo
- **Primary Source excerpts** for analysis and comparison
  - Euclid's Geometrical Method
- **Iconic Images**
  - Boldly Explore: Camille Flammarion (1888) (Learning Leaflet)
  - Johann Kepler: Blueprints of the Universe (Learning Leaflet)
- **2-minute stories**
  - Johann Schreck: Galileo's Friend in China (Learning Leaflet)
- **Women in Science**
  - Hildegard of Bingen: An Abbess for Health Care (Learning Leaflet)
  - Maria Cunitz: Kepler's Defender (Learning Leaflet)
  - Elizabeth Hevelius: Observational Astronomer (Learning Leaflet)

For now, on the lynx blog, they are listed by series…



- Catherine Whitwell: Astronomy and Creative Writing (Learning Leaflet)
- *Urania's Mirror*: Constellation Cards (Learning Leaflet)
- Ada Lovelace: First Computer Programmer (Learning Leaflet)
- Florence Nightingale: Professionalized Health Care (Learning Leaflet)

- **Instruments and Experiments**
  - Introduction to the Duochord: Music and Mathematics (Learning Leaflet; OER Commons).
  - Introduction to Sundials (Learning Leaflet; OER Commons).
  - Introduction to the Planisphere: (Learning Leaflet; OER Commons).
  - Introduction to the Celestial Globe (Learning Leaflet; OER Commons).
    1. Horizon (Learning Leaflet; OER Commons).
       - Introduction to a Protractor Sextant/Quadrant
       - Find your latitude by measuring the altitude of Polaris
    2. Celestial Equator (Learning Leaflet; OER Commons).
       - Diurnal Motion (Learning Leaflet; OER Commons).
       - Introduction to the Nocturnal Dial: Tell time by the stars
    3. Ecliptic
       - The Zodiac
       - Zodiacal Motion of Planets
  - Armillary Sphere
  - Astrolabe
  - Orrery (Planetarium)
  - Tellurian
  - Sextant
    - Introduction to a Protractor Sextant/Quadrant
    - Stellar Parallax
  - Celestial Coordinates: Flamsteed
  - Abacus: Simple Addition
  - Napier's Bones
  - Slide Rule: Simple Multiplication
  - Galileo's Engineering Compass
  - Galileo's Telescope (Learning Leaflet; OER Commons).

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Expand

OUHOS Collections @OUHOSCollection 26 Oct
#Magic = practical part of #naturalphilosophy in 1658 Natural Magick @GalileosWorld @SamNobleMuseum #SpookyStacks pic.twitter.com/DOb1zzUGkl
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Our Hashtags
- #GalileosWorld
- #ouhos
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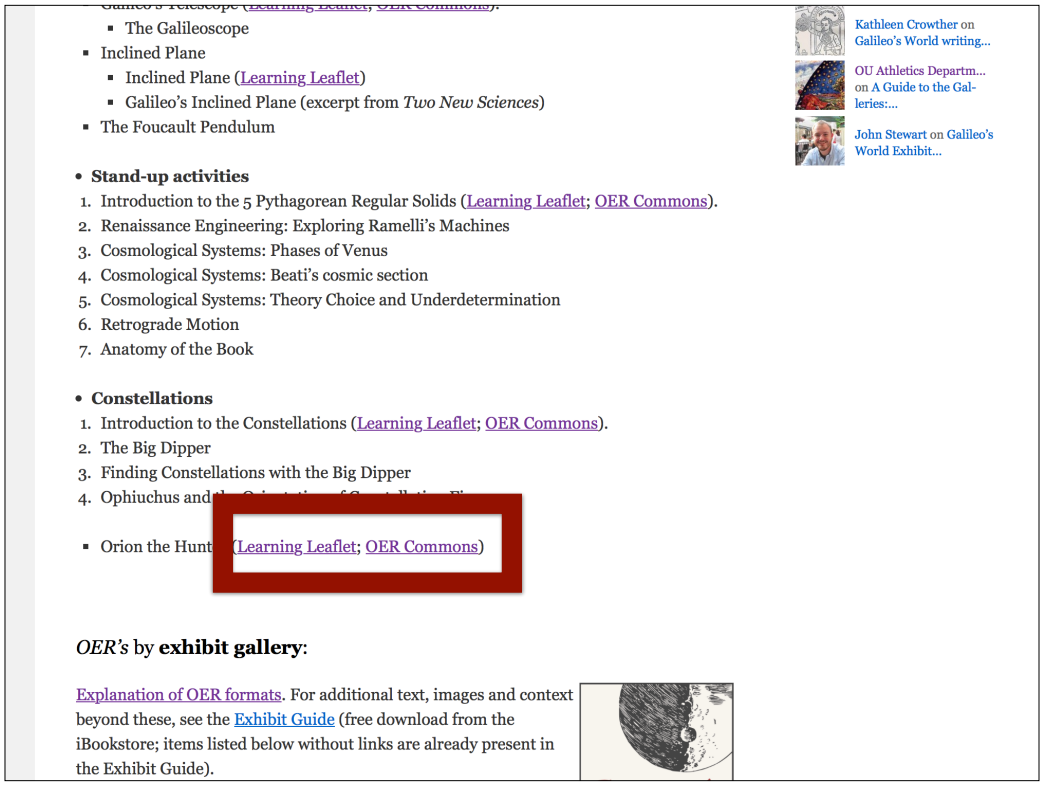
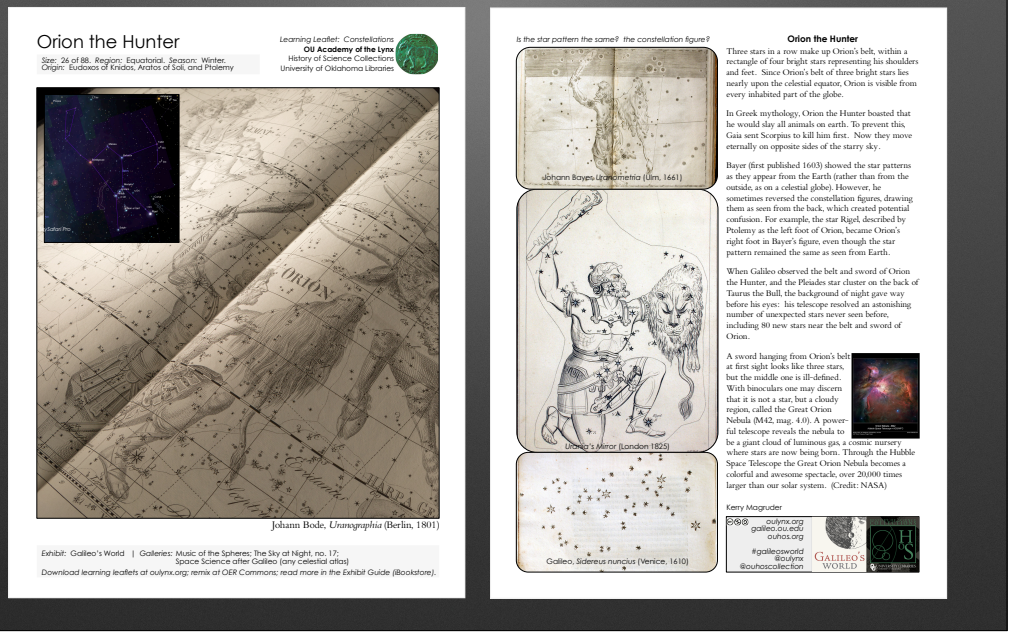
Recent Comments

If there are no links, then they're already in an iPad Exhibit Guide and will soon appear in the leaflet format.

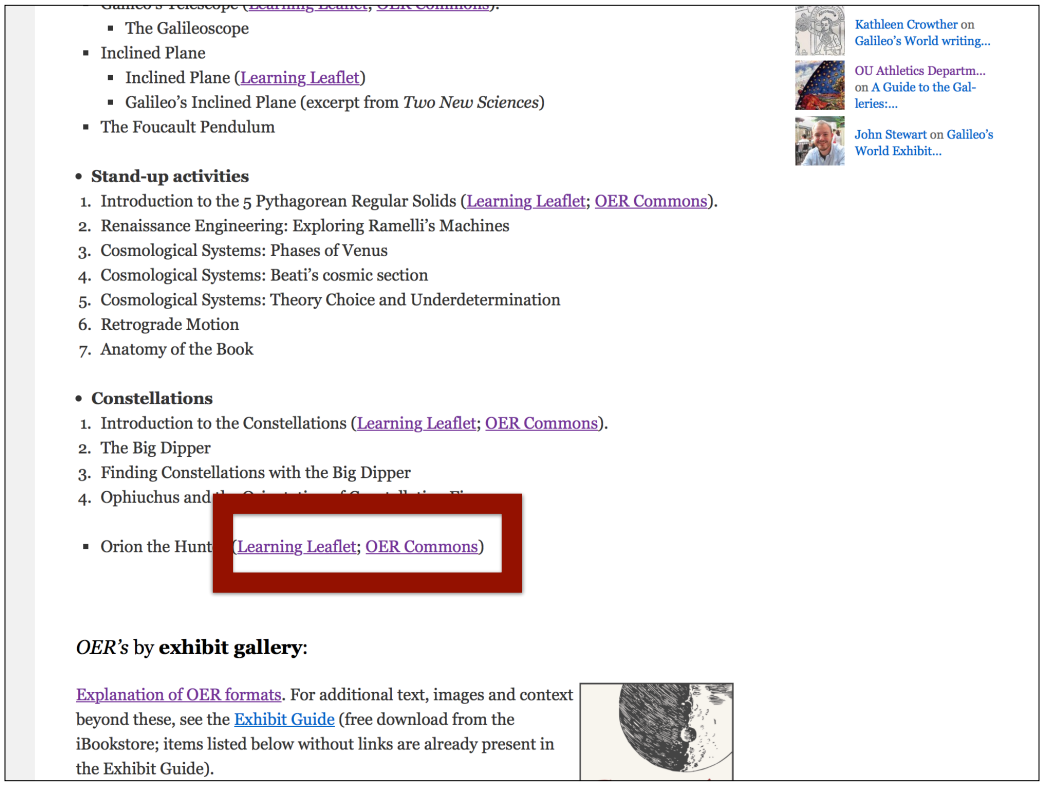


After the name of an OER, you'll see links for the formats in which it is available. This one is for Orion the Hunter. The first link takes you to the Learning Leaflet

Orion the Hunter



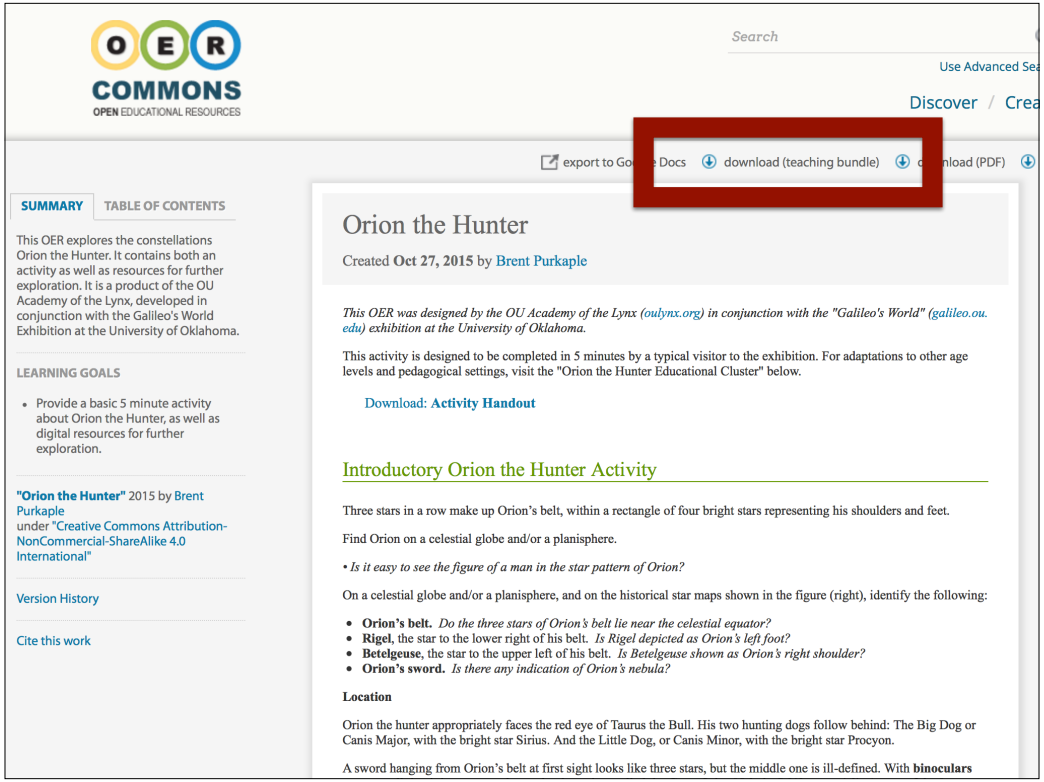
Which looks like this.



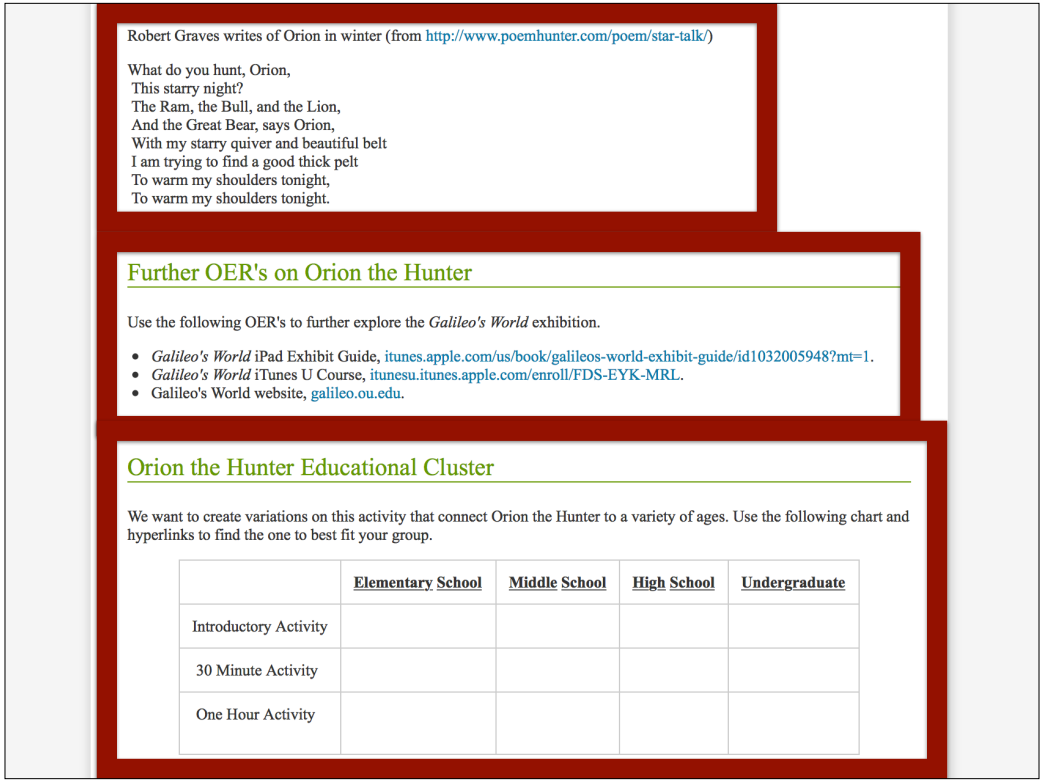
The second link takes you to OER Commons.

Collaborative “Joining”

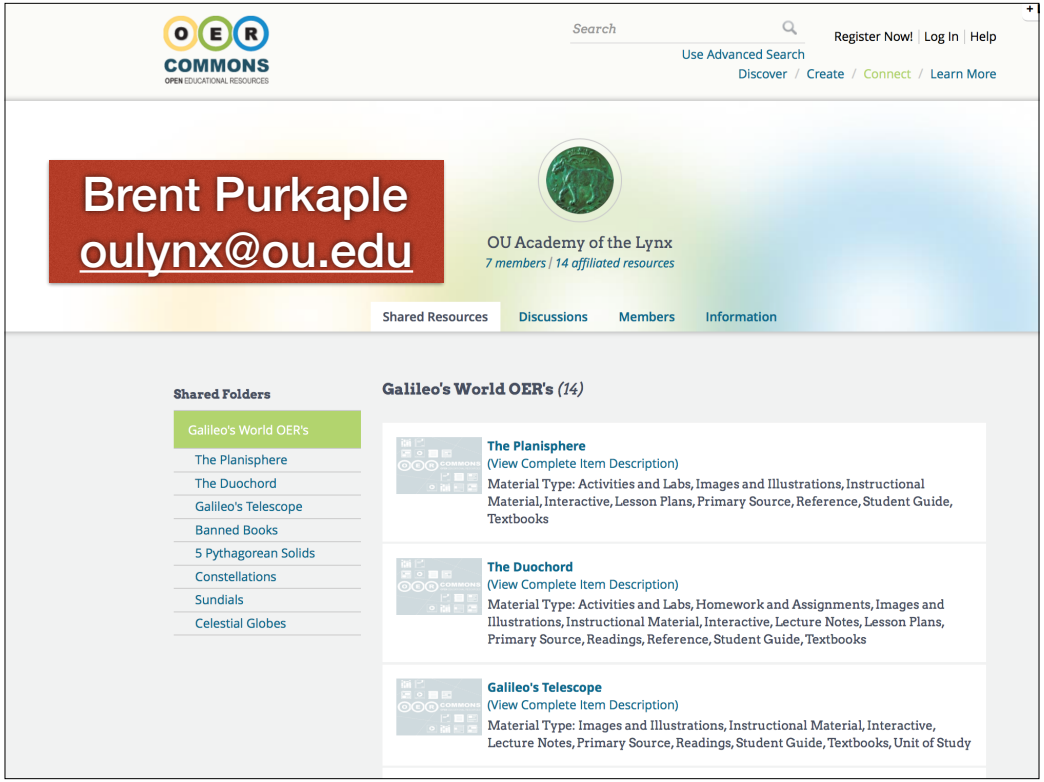
which looks like this. OER Commons is a repository for educators to share activities and learning resources. Learning resources may be tagged according to specific educational standards in multiple subject areas and age levels for each state. Educators may customize existing activities to fit their own needs. Here is where we move from our “small pieces” into the “joining” effort, by collaborating with educators to serve multiple contexts.



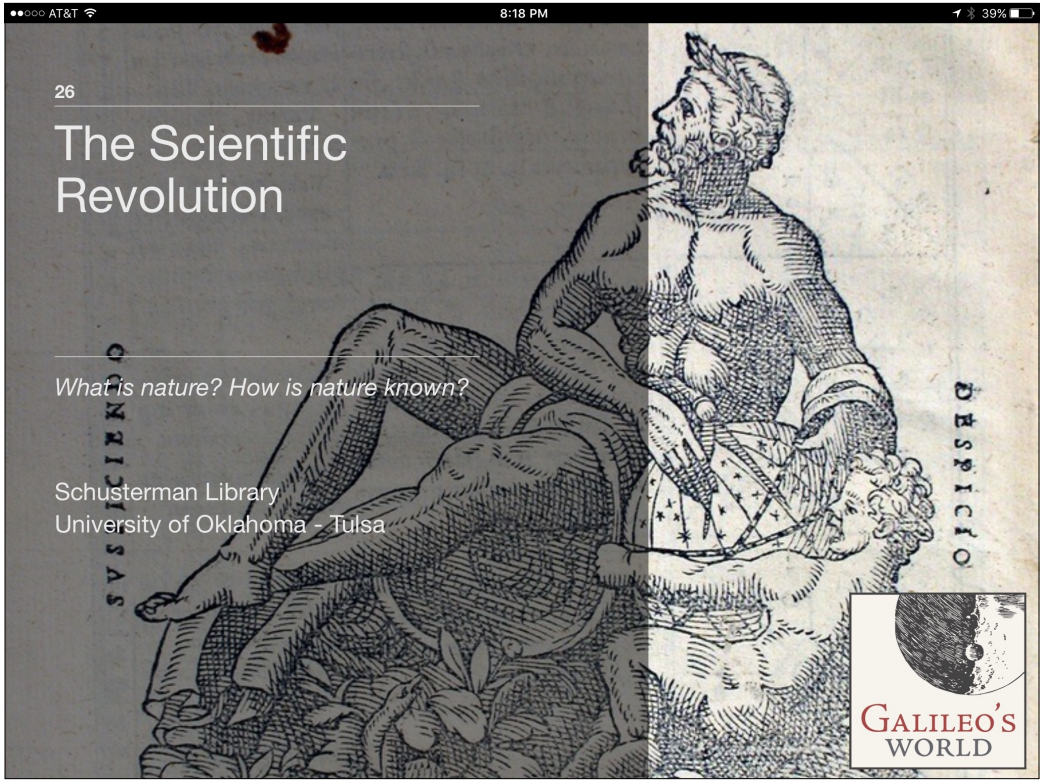
Visit the OU Lynx pages at OER Commons to download related materials, along with the original images, in order to remix them for your own use.



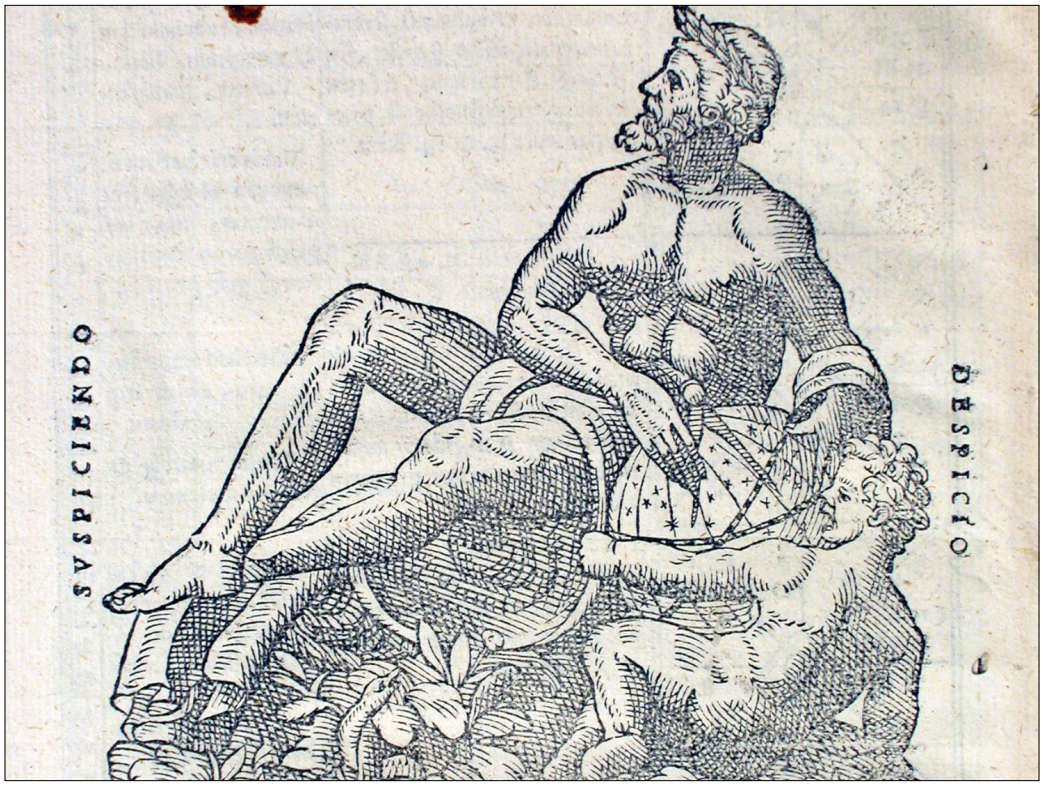
At OER Commons we can offer slightly longer versions of the leaflet text,
and links to OER's from other sources.
We are recruiting educators who will work with us to develop longer versions of these activities and resources, and as we do so we will add links to the matrix at the bottom of each OER page.



We've only just started, beginning this semester. Many more OERs will be added over the course of the year. • Subscribe to the oulynx blog for updates, or contact me by email.



KERRY: To conclude, I'd like to mention the exhibit in Tulsa on the Scientific Revolution.



Its emblem comes from the motto of Tycho Brahe, “looking up, I look down.” Tycho coordinated the study of astronomy (looking up) with the study of medicine, chemistry and geology (looking down). This emphasis on connections between different disciplines encourages us all today to consider the lessons we might learn from the history of science.

BRENT: Many of you have piloted a project like ours. Please tell us what we will wish we had known! We welcome your suggestions and advice. In particular, we would like to know if any of you have had experience with OER Commons.

Q & A

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