

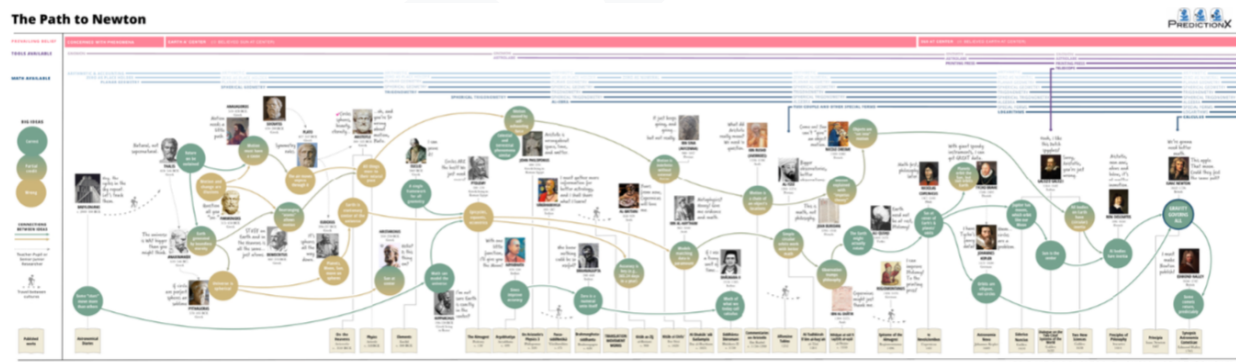
The Path-to Science Consortium



Executive Summary

The Path-to Science Consortium will research, create, and distribute educational materials that will entice learners and the public to learn more about science through its history, and history through science. Founding members will include the University of Padua, University of Oxford, and Harvard University, all of which house rich collections and scholarship related to the history of science. Initial activities of the consortium will include undergraduate, graduate, postdoctoral, faculty, and curator exchanges and fellowships, as well as workshops, colloquia, and public talks, all designed to facilitate development, testing, and/or dissemination of the Path-to Science Consortium's educational materials. Member university's museums will also collaborate via personnel and material exchanges, and in the creation of new exhibits and online offerings.

Background



The [Path to Newton \(PtN\)](#), which inspired the founding of the Path-to Science Consortium, was originally [published](#) online in 2019, as part of [The Prediction Project](#)¹. Online, the PtN interconnects a narrative description and an engaging infographic that represents the intertwined paths through history that led to Newton's predictive theory of gravity. Beginning with ancient

¹ The Prediction Project, founded by Prof. Alyssa Goodman, began at Harvard in 2015 as a collection of online materials, called “PredictionX,” tracing the history of prediction from ancient Mesopotamians’ use of sheep entrails to modern Climate Change forecasts. Early materials were presented on the edX platform, and they include special features on traditional prediction techniques, as well as the origins of epidemiology and navigation. Since its founding, The Prediction Project has spun off a Freshman [Seminar](#) and a General Education [course](#) on-campus at Harvard, as well as several online products, including the [Path to Newton](#), available through [predictionx.org](#).

Babylonians' interest in the changing appearance of the night sky and ending with Halley's prediction of a comet's return, the PtN highlights a wide variety of cultural, scholarly, and religious ideas that led both toward and away from a successful theory of gravity. It offers a novel way to appreciate and understand history through the history of science, and science through its history. It is also suitable for printing, as a large-format poster. Please click on the image above to experience the Path to Newton online.

The "Padua Rainbow"



In 2019, Goodman gave a [talk](#) about The Prediction Project at the University of Padua, in which she contrasted the history and methods of prediction in the **physical sciences** with those in the **life sciences**. A desire to avoid using philosophical jargon about deductive, inductive, abductive, etc. reasoning in the Padua talk led to the creation of the so-called **Padua Rainbow**, which offers a convenient rubric for describing elements of the process of science and a simple way to ponder how progress is made in science. (Please click the rainbow above for details.)

The Padua talk also inspired the (in-process) **Path to Darwin**, which will offer an online interactive view of the developments that would have helped/hindered Darwin's thinking. Subsequently, in 2022, the nonprofit "**Path-to Foundation**" was founded² with the aim of: 1) creating Paths to more modern times, notably from Darwin to Modern Genetics and from Newton to Einstein; and 2) developing and distributing materials, curricula and exhibits based on the Paths.

In the Fall of 2022, Alyssa Goodman visited **Oxford** and **Padua** to interview a wide variety of historians, scientists, and museum curators as part of an expansion of the Prediction Project's audio and video offerings. During these conversations, which covered wide swaths of the [Prediction Project's broad agenda](#), interviewees near-universally fixated on the Path to Newton and the Padua Rainbow, and made unsolicited offers to help tell the story of science through its history rather than (just) equations. Harvard, Oxford, and Padua all have exceptional collections of scientific instruments and experts who study those instruments' use. So now, with a great assortment of Harvard's, Oxford's and Padua's leading scientists, historians, and curators expressing interest in researching, creating, and disseminating new Path-to materials, we seek to establish the consortium and begin the activities described below.

Notes on our "Path" to Establishing the Consortium

1. Circulate this **draft** for review, vet(ted) via discussions, as follows:
 - a. Prof. Alyssa Goodman with Oxford Pro-Vice-Chancellor [Anne Trefethen](#) in London, December 1, 2022
 - b. Profs. Alyssa Goodman & Immaculata DeVivo with University of Padua Vice Rector of Wellness and Sport [Antonio Paoli](#) and Prof. [Tatiana Moro](#) in Cambridge, MA, December 13, 2022

² Initial funding for the Path-to Foundation will come from revenues generated by learners on edX purchasing "verified certificates" related to The Prediction Project.

- c. Prof. Alyssa Goodman with Harvard Dean [Christopher Stubbs](#), [Harvard Museums of Science & Culture](#) Executive Director [Brenda Tindal](#) & History of Science Chair Prof. [Elizabeth Lunbeck](#) on zoom, December 16, 2022
- d. Profs. Alyssa Goodman and Immaculata DeVivo with Harvard Vice Provost for International Affairs [Mark Elliott](#) (scheduled for January 23, 2023)
2. Create **final “proposal”** to be sent to institutional representatives suggested below
3. Send proposal to representatives, with explanatory **cover letters**, as-needed
4. **Discussions** of MOUs amongst institutional **representatives**, expected initially to be:
 - a. [Prof. Antonio Paoli](#), University of **Padua** Vice Rector of Wellness and Sport
 - b. [Prof. Anne Trefethen](#), University of **Oxford** Pro Vice-Chancellor (People and Digital)
 - c. [Prof. Mark Elliott](#), Harvard University Vice Provost for International Affairs

These discussions will include

—expanding the memoranda of understanding currently in-place between

Padua-Harvard, to extend to all fields of study related to the history of science, rather than just life science, as the MOU covers now

Padua-Oxford, (as-needed) to extend to all fields of study related to the history of science

—and adding a new MOU, for:

Oxford-Harvard, to complete the triangle, covering all fields of study related to the history of science

Note: If appropriate, the consortium can be joined or facilitated by the nascent **“Path-To Foundation,”** a not-for-profit 501(c)(3) established to use the proceeds of the Harvard Prediction Project to expand that project’s reach.²

Added May 9: 2023, needs to be cleaned-up, integrated into the above/below. [Comet discussions](#)
[Harvard:Oxford 2022-](#), [Padua:Harvard Path-to Startup Items](#)

Activities Envisioned

Initial Activities

Fellowship and exchange opportunities

Depending on the expertise of the fellow, and duration of involvement/visit, activities could include:

- researching and/or helping to create additional **Paths** (Darwin, Modern Genetics, Einstein)
- independent and collaborative study related to ongoing **research** in the:
 - **history of science** (including using physical collections); and/or
 - the **history of knowledge** (including using library and museum holdings) and its dissemination

- expanding on university course work to include “**field trips**” to physical **collections** (both locally and across universities)
- **curation** of in-person or online exhibits and events described below

The level and duration of these fellowships and exchanges could include:

- a one-off, initial, **one-year graduate student fellowship**, designed to help refine Consortium ramp-up plans, in terms of academic programs, funding opportunities, and logistics (funds would cover the cost of travel between, and residence at, the consortium partner universities)
- **undergraduate student exchanges**
 - *from Harvard*: “January Term” 1-month visits by Harvard undergraduates to Padua and Oxford, year-abroad programs from Harvard to Oxford, Padua (funds may already be in-place at Harvard, Chris Stubbs can confirm)
 - *from Oxford*: [Anne Trefethen can suggest]
 - *from Padua*: [Antonio Paoli can suggest]
- **graduate student, post-doctoral, and faculty exchanges**
 - funding/sponsorship opportunity for a “travel fellowships” for scholars, at any of the founding universities

Events and Exhibitions at each of the Consortium Universities

As each of the founding Consortium Universities is known for their history of science museums, and for hosting the world’s most productive academic gatherings, it is expected that a variety of **programs** will be proposed by consortium members, designed to showcase the consortium’s output as the collaboration proceeds.

Oxford’s [Open Cabinet tool offers AR access to Oxford’s collections](#), and Oxford’s staff are interested in sharing this technology/platform with Harvard and Padua museums, and in a 3-way exchange around platforms for sharing collections online in innovative ways.

Curriculum Materials, Development and Dissemination

The PtN itself is already integrated into several Harvard [courses](#), whose curricula are available online. It is expected that it will be easily integrated into relevant courses at Padua and Oxford, and beyond. A goal of the consortium will be to popularize these curricula, and also to research how best to integrate the Paths into lower (high-school) level curricula and online course offerings, in addition to those at university.

Potential Expansions

Broadening the Collaboration

Institutions whose members have already expressed interest, include:

- [NASA’s Science Activation Program](#) (contact at NASA: Kristen Erickson)
- The [American Astronomical Society](#), for Newton/Einstein (contact at AAS: Tom Rice)

- [LabXchange/AMGEN](#), for Darwin/Modern Genetics (contact at LabXchange: Alain Viel)
- The [Jackson Laboratory](#), for Darwin/Modern Genetics (contact at JAX: Ed Liu)
- The [American Museum of Natural History/Hayden Planetarium](#) (contact: Neil De Grasse Tyson)
- The ESO “Supernova” Museum and Outreach Center (contact: TBD)
- [MUSME](#) The Museum of the History of Medicine in Padua (contact : TBD)

Multimedia Opportunities

Crash Course Prediction, Lecture Series: Alyssa Goodman has been approached by the producers of [Crash Course](#) to create a short “lecture” series on Prediction. As this is likely to happen in 2023, it might offer one of the first opportunities for widespread dissemination of Path-to Materials.

A Docudrama episode on Comets: Discussions are underway about re-presenting some of the material in the broader Prediction Project as a docudrama, in a style appropriate to Netflix, AppleTV+, or HBO. The likely first “pilot” of this docudrama series would feature The Path to Newton as part of a storyline demonstrating how humans have gone from being mortally afraid of comets as harbingers of doom to being able to land spacecraft on a comet. (At least) Harvard’s Sara Schechner, John Overholt, and Alyssa Goodman, along with Oxford’s Chris Lintott and Rob Iliffe would play key roles in creating this docudrama, as would Galileo experts at Padua.

Augmented Reality ongoing work at Harvard using augmented reality (in Goodman’s [astrophysical pursuits](#), and at the [Harvard Museums of Science and Culture](#)) could bring collections “into the hands of” more learners, online and in-person at museums

Traveling Exhibition

Discussions would commence once this collaboration is established.

Potential Sources of Financial Support

[To be discussed amongst proposing Consortium members, as MOUs are revised/created.]

- Proceeds from edX portions of the Prediction Project
- Donations to the Path-to Foundation
- Donations to University of Padua
- Donations to University of Oxford
- Donations to Harvard University
- Foundation support in the US to Harvard (governmental & private), for example from [Sloan](#)
- Foundation support in the UK to Oxford (governmental & private)
- Foundation support in Italy to Padua (governmental & private)

Academic Leads

Note: Dozens of experts beyond the leads listed here will be eager to be part of the Consortium's activities. They include a large fraction of the >45 experts who had participated in the Prediction Project prior to Fall 2022 (listed [here](#)), and several others who participated in the context of Fall 2022 UK interviews (listed [here](#).)

Harvard

- Prof. [Alyssa Goodman](#), Robert Wheeler Willson Professor of Applied Astronomy, Founder of the Prediction Project (Harvard Faculty of Arts & Sciences, Harvard University)
- Prof. [Immaculata De Vivo](#), Professor in the Department of Epidemiology (T.H. Chan School & Harvard Medical School)
- Dr. [Sara Schechner](#), David P. Wheatland Curator, Collection of Historical Scientific Instruments (Harvard University Museums of Science and Culture)
- Dr. [John Overholt](#), Curator of the Donald and Mary Hyde Collection of Dr. Samuel Johnson and Early Books and Manuscripts, Houghton Library (Harvard Faculty of Arts and Sciences)

University of Padua

- Prof. [Antonio Paoli](#), University of **Padua** Vice Rector of Wellness and Sport
- Prof. [Cristina Basso](#) - Vice Rector for International Relations
- Prof. [Monica Salvadori](#) - Vice Rector of Historical and Cultural Heritage
- Prof. [Mauro Varotto](#) - Delegate for Museums and Collections
- Prof. [Telmo Pievani](#) - Delegate for Communication and Scientific Dissemination
- Prof. [Fabrizio Nestola](#) - Director of The Museum of Nature and Humankind
- Prof. [Flavio Seno](#), Head, Dipartimento di Fisica e Astronomia “Galileo Galilei”

Oxford

- Prof. [Rob Iliffe](#), Professor of History of Science at Oxford, Co-Director of the Oxford Centre for the History of Science, Medicine and Technology, and a General Editor of [the Newton Project](#).
- Prof. [Richard Ovenden](#), Bodley's Librarian, University of Oxford
- Dr. [Silke Ackerman](#) TBC–*Sara Schechner to confirm*

The Path-To Foundation (if applicable)

- [Jais Brohinsky](#), Graduate Student, University of Wisconsin, lead researcher for Path to Newton
- [Drew Lichtenstein](#), Senior Instructional Designer, Colorado State University

It is likely that funding will be sufficient within the Consortium's first year to support an Executive Director or Coordinator for this program, based at one of the three founding institutions.

Appendix A: About The Path-To Foundation (reproduced from its [website](#), October 2022)

The Path-To Foundation was established in 2022, with a mission to make science more human.

Sometimes, the way science is taught and communicated, it seems as if there is some kind of magic formula or method used by scientists to discover life's and the universe's mysteries. But, that's not true. Instead, the history of what we today call "science" is a constantly evolving conversation about truth. The Path-To Foundation's work focuses on explaining that conversation, and trying to bring more people into it.

Throughout history, people around the globe have invented and used a vast variety of approaches to understanding how the world works, sometimes with spectacular success. Anyone who's taken physics in school, or marveled at the reality of space exploration, can appreciate that Isaac Newton's theory of gravity—with its ability to accurately predict the paths of bodies in motion—exemplifies a fundamental breakthrough of a sort rarely rivaled in the history of science.

In 2019, "The Path to Newton" (which has now become our prototype path) was published online as part of The Prediction Project at Harvard, and its success inspired the establishment of the Path-To Foundation. The Path to Newton illustrates and explains interconnections over time amongst the wide variety of cultures, people, ideas, and technologies that ultimately made it possible for Newton to produce his theory of gravity. Importantly, it shows how ideas that today's experts would designate as "correct" or "incorrect" propagate forward in time, influencing the thinking of future generations.

Today, the Path to Newton is available as an online interactive experience where users can click on images of scientists, or their ideas or writings, to access a narrative description of the history leading to Newton's theory of gravity. The Path to Newton can also be printed as an inspiring poster that offers an overview of the full story offline. The path begins in Ancient Mesopotamia and ends with Edmund Halley using Newton's theory to predict the return of "Halley's Comet."

The Path-To Foundation's work includes the creation of additional paths, beyond The Path to Newton, including:

- The Path from Newton to Einstein
- The Path to Darwin
- The Path from Darwin to Modern Genetics

As each path is released online, free to all who want to learn and teach using it, additional curricular materials are added as well.

We hope that the materials created by the Path-To Foundation will engage and intrigue learners of all ages, from all backgrounds, with a variety of interests, all over the world. And, most of all, we hope to increase the appreciation of science as an ongoing conversation, where rigorous methods of debate are applied—but no answer is ever "final."

Appendix B: Links to related projects

- [Harvard Case Histories in Experimental Science, Volume I — James Bryant Conant](#)
- [Where Did The Test Come From? - Americans Instrumental In Establishing Standardized Tests | Secrets Of The Sat | FRONTLINE | PBS](#)
- [Harvard Project Physics - Wikipedia](#)
- [Harvard Project Physics: The Role of History in Science Curriculum](#)

Appendix C: Links to Information related to Potential Future collaborators/Consortium Members

- The [Omni Group](#), who make the OmniGraffle software used to create the Path to Newton, and who featured the Path to Newton on their Podcast, [The Omni Show: Harvard Professor Dr. Alyssa Goodman On Data Visualization with OmniGraffle](#)
- [The Crash Course](#), with whom Prediction Project and LabXchange leaders have already been discussing a partnership around dissemination of Prediction Project Materials

Appendix D: Links to related programs and studies, ongoing & past

- [Harvard Project Physics: The Role of History in Science Curriculum](#); see also 1969 interim summary by Gerald H
- [olton](#) (PDF)
- [A Typology of Approaches for the Use of History of Science in Science Instruction | SpringerLink](#)
- Conant, J.B. ed., 1957. *Harvard case histories in experimental science*. Harvard University Press. [Full text of "Harvard Case Histories In Experimental Science Volume I"](#) (background/review [here](#), extensive relevant citations to this seminal work [here](#))
- [Science Teaching](#) The Contribution of History and Philosophy of Science, 20th Anniversary Revised and Expanded Edition, Michael R. Matthews (history of methods/approaches)
- [The History of Science And The Future of Science Education](#) (McComas, 2011)

Notes from meetings discussing this document *(to be removed once document is edited into circulating format)*

December 1, 2022 (London, UK): Alyssa **Goodman** (Harvard FAS), Anne **Trefethen** (Oxford)

conclusion: Oxford remains enthusiastic about this project overall, and Anne Trefethen may be able to join us in Padua in person on January 30, when we meet with U. Padua representatives (TBC)

December 13, 2022 (Cambridge, MA): Alyssa **Goodman** (Harvard FAS), Antonio **Paoli** (U. Padua), Immacolata **De Vivo** (Harvard CSPH)

conclusion: U. Padua would like expand the Harvard:Padua MOU to go beyond health/life science topics, and would like to move ahead with this plan—Paoli was planning to speak with the Rector before Christmas (AG sent follow up message to Paoli about this on 3 January 2023)

December 16, 2022 (zoom), Alyssa **Goodman**, Chris **Stubbs**, Brenda **Tindal** & Elizabeth **Lunbeck**

conclusions: AG wrote to Mark Elliott (asking if we can have a “boilerplate” MOU; cc Chris & possibly Alan; she will mention that we need to expand Harvard-Padua MOU beyond school of public health)

separately—pursue specifics of programs—CHSI Peter Gallison Sarah, are talking about having a museum studies program... new director, and Peter G et al., will need to be on board.

additional relevant information: Janet Brown is retiring & Hannah Marcus is on leave, up for tenure, but they will be interested. conversations with Elizabeth Lunbeck & Peter Gallison, and full History of Science faculty should be planned for “after the semester is in full swing”

January 23, 2023

AG, IdV, and Mark Elliott to meet for update

January 30, 2023 expected are Alyssa Goodman (Harvard FAS), Immaculata De Vivo (Harvard CSPH), Antonio Paoli (U. Padua), and others representing Padua

goal (met): agree on plan for the consortium, have assurances on the use of existing and/or future MOUs, discuss funding

(positive!) results summarized 2/1/23 in [this email](#)

February 7, 2023

Alyssa Goodman (spoke with Silke Ackerman via zoom. Silke will ask her director colleagues for a “wish list” of potential Oxford involvements at a meeting on 8 February 2023. Silke will use this document to guide the discussion. Alyssa & Silke also agreed that collaborating on a joint proposal to Sloan might be a good idea, using this solicitation. [Call for Letters of Inquiry: Historical Research on the Practices and Institutions of Social and Natural Science](#)

Alyssa also explained that “staffing” could be provided, in part, for the project in the form of a visiting graduate student, likely Jais Brohinsky, supported with a special 1-year-traveling fellowship. Jais, who was the lead researcher for the Path to Newton, and is currently a PhD candidate in education at U. Wisconsin, is excited to work with all consortium members to establish joint educational and research goals, and to help execute initial programs and collaborations,

(also)

Alyssa Goodman spoke with Drew Lichtenstein & Jais Brohinsky via zoom. They each remain interested in roles as Jais—potential grad student researcher for 1 year fellowship to establish consortium goals/plans, and Drew—executive director of Path-to project/foundation, should Sloan/other funding materialize.

much more to be added...

Kathryn Eccles, Cabinet

Alumni trip

5 MIT books, Path-to Darwin++

various talks

MOU signing

raise\$\$ (no more Padua\$)