NEH Application Cover Sheet (MT-258876)
Digital Projects for the Public: Prototyping Grants

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Field of expertise: History of Science

INSTITUTION

The Chemical Heritage Foundation
Philadelphia, PA 19106-2702

APPLICATION INFORMATION

Title: *Age of Alchemy: The Goldsmith's Daughter*

Grant period: From 2018-01-02 to 2018-12-31
Project field(s):   History of Science; Art History and Criticism; Women's History

Description of project: The Chemical Heritage Foundation (CHF) is developing Age of Alchemy, a game exploring alchemy's "Golden Age" in Europe during the 1600s. In this era, alchemy was not a fool's quest for riches and eternal life: it provided economic opportunity, invited curiosity, and examined relationships between humankind and the natural world. Alchemy formed our current ideas about experimental scientific practices and paved the way for modern chemistry. It also impacted period literature, visual art, and music and continues to excite public imagination. Age of Alchemy draws on CHF's collections of alchemical art and rare books to produce a visually rich and historically accurate experience, awakening empathy for past individuals who used experimental work to navigate society. During this prototyping phase, we will work with playtesters and our advisory team of experts to shape key game mechanics and assess levels of audience engagement and the successful communication of our humanities themes.

BUDGET

Outright Request	100,000.00	**Cost Sharing**	97,420.00
Matching Request	0.00	**Total Budget**	197,420.00
Total NEH	100,000.00		

GRANT ADMINISTRATOR

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Age of Alchemy:
The Goldsmith's Daughter
A Game Prototype

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2. ABSTRACT

The Chemical Heritage Foundation is developing *Age of Alchemy*, a game exploring alchemy's "Golden Age" in Europe during the 1600s. In this era, alchemy was not a fool's quest for riches and eternal life: it provided economic opportunity, invited curiosity, and examined relationships between humankind and the natural world. Alchemy formed our current ideas about experimental scientific practices and paved the way for modern chemistry. It also impacted period literature, visual art, and music and continues to excite public imagination. *Age of Alchemy* draws on CHF's collections of alchemical art and rare books to produce a visually rich and historically accurate experience, awakening empathy for past individuals who used experimental work to navigate society. During this prototyping phase, we will work with playtesters and our advisory team of experts to shape key game mechanics and assess levels of audience engagement and the successful communication of our humanities themes.

Age of Alchemy: The Goldsmith's Daughter
A Game Prototype

3. APPLICATION NARRATIVE

3.A) Nature of the request:

The Chemical Heritage Foundation (CHF) is requesting $100,000 to design, test, and prototype key aspects of *Age of Alchemy*, an interactive game designed for mobile devices. Alchemy has long been misunderstood as a fool's quest for quick riches and everlasting youth, yet its discoveries helped shape our understanding of the natural world and humanity's place within it. Over the past 20 years, scholars have recovered alchemy as a scientific and humanistic discipline in the early modern era, but rarely is this research presented to public audiences. CHF has worked to challenge past interpretations of alchemy through sustained scholarly research, public programs, and exhibitions. *Age of Alchemy* builds on this work to reveal alchemy's literary, cultural, and creative dimensions, drawing players into the economically and socially diverse arenas of alchemical workshops, apothecaries, and laboratories in the 1600s. The visual world of *Age of Alchemy* reinterprets CHF's extensive collections of fine art and rare books, from naturalistic Dutch paintings of busy workshops to cryptic recipes in books of secrets, and transforms these materials into a tactile, visually spectacular, and immersive experience.

We are partnering with Gossamer Games, a Philadelphia-based independent game studio that works with the Entrepreneurial Game Studio (EGS) at the ExCITe Center of Drexel University, to develop an interactive digital prototype for *Age of Alchemy*'s first module *The Goldsmith's Daughter*. Gossamer Games specializes in creating accessible aesthetic-driven gameplay experiences that explore games as an empathetic and expressive art form. EGS brings deep knowledge of innovative game practice, fluency with navigating academic circles, and experience curating engaging digital games for the public. The CHF–Gossamer–EGS partnership unites multiple sets of humanistic and digital expertise to create a game that is historically grounded, visually compelling, and informed by contemporary research on innovative gameplay. In the proposed prototyping phase, we will test essential aspects of the game, gathering feedback and data regarding the efficacy of storytelling content and delivery, accuracy of historic content, satisfaction of gameplay mechanics, and the difficulty and enjoyment of puzzle sequences. By the end of the prototyping period, we will produce two sets of interactive content. The first set tests specific player interactions (mechanics) inspired by the game's three core dynamics: explore, interpret, and experiment. These tests will allow us to assess player engagement before the mechanics are fully implemented into the game. The second set tests interactive storyboards for the prototype's five levels, simulating player decision points that will be expanded in later phases of development. This completed prototyping phase will lead to structuring our application for an NEH Production Grant to fully develop and deploy *Age of Alchemy*.

3.B) Humanities content:

How and why do we work to understand the natural world around us, and how and why do we attempt to transform it? These questions, which continue to form the core of artistic and scientific innovation, lay at the central aims of early modern alchemy. Despite its ubiquity until the mid-1700s, alchemy has since been misunderstood as occult magic or a delusional search for riches. However, humanities research over the past 20 years has revealed alchemy as both a creative art and an

experimental science. Alchemy offered both tools and techniques, and also a method for manipulating the natural world and thereby understanding humanity's place in the cosmos.

Age of Alchemy explores a key moment in time when art, language, and literature were integral to science, medicine, chemistry, and experimentation. Early modern alchemy was a testing ground. It was not always culturally accepted, not always done well, and sometimes led to disastrous results. But its impact was undeniable and its discoveries helped shape the modern world. The purpose of this digital game is to engage our audiences in this compelling humanities content in an immersive, playful, and novel way. Through stories, characters, playful puzzles, rich visuals, immersive settings, music, art, symbology, adventurous action, and impactful decision-making, we will invite users to engage in strategic play that explores the fascinating, rich, and often obscured impact that alchemy has had on the cultures of art and science.

Age of Alchemy will create a playful and experimental path to understanding the goals and cultural importance of alchemical practice. Our proof-of-concept game module, *The Goldsmith's Daughter*, will focus on the fictional character of Viola, a goldsmith's daughter living in London during the mid-1600s. As a woman, Viola is barred from taking over her father's goldsmith shop. At the start of the game, she is about to be married to a man who will stand to inherit her father's business and who is uninterested in Viola as an active partner in the shop. The game's five levels follow Viola as she risks everything to trick her father, escape her impending marriage, and set off on her own alchemical quest. The game is set in the active city center of London so that players can interact with English-language period texts. A majority of the paintings, works on paper, and rare books held in our collections date from the mid-1600s, allowing game design to draw from rich, historically relevant sources. The inclusion of Dutch and Flemish paintings as visual source material will allow players to learn about the lively artistic and scientific exchange between the Netherlands and England during this period, and can eventually contribute to future game modules that unfold outside of England.

This first game module will be structured around three core humanities themes:

1. ***Alchemy as a Cross-Disciplinary Endeavor.*** Alchemy was a cross-disciplinary early modern practice dedicated to understanding the natural world, and thus it is crucial to both the histories of science and art.
2. ***Diversity of Alchemy's Practitioners.*** Alchemy was a pursuit practiced by individuals who ranged from elite "experts" to working artisans. Alchemists existed at different levels of society, traveled across geographic boundaries, and worked in and for many different communities.
3. ***Women's Networks of Alchemical Practice.*** Recent historical research has shed light on women's important roles as alchemical practitioners and theorists, reversing past neglect of women's participation in empirical work.

The mystery and romance of alchemy invites curiosity, but its realities are far more compelling. Leading contemporary historians of science, including Lawrence Principe (*Chymists and Chymistry,* 2007), Bruce T. Moran (*Distilling Knowledge,* 2005), Tara Nummedal (*Alchemy and Authority in the Holy Roman Empire,* 2007), William R. Newman (*Promethean Ambitions,* 2004), and Pamela Smith (*The Body of the Artisan,* 2004), have worked to restore alchemy's reputation within the scholarly community. Early modern alchemists were engaged in a wide array of enterprises, from mining and metalworking, to dye and pigment manufacturing, to the production of chemical medicine and the study of natural phenomena. Alchemical treatises circulated knowledge across a broad spectrum of

society, from artisans and tradesmen to scholars and princes. CHF houses a treasure trove of depictions of early modern experimenters from the 1500s through the 1800s, including more than 100 paintings and 200 works on paper. In addition to paintings and prints, the CHF Othmer Library of Chemical History holds roughly 1,000 volumes of rare books and manuscripts related to alchemy, many of which are richly illustrated. The *Age of Alchemy* game project puts CHF's interrelated collections in dialogue with one another in an accessible format created for public audiences, allowing players to step into the past and experience the humanistic dimensions of early modern scientific knowledge-making.

The public's understanding of alchemy and its role in shaping our modern ideas of transformation and matter remains clouded by associations with occultism and fraud. Images of alchemy, both portrayals of workshop practice and alchemical symbology, have remained largely impenetrable to the broader public, who are unfamiliar with the period's symbolism and complex visual and literary allegories. Moving beyond the scholarly page and outside our museum walls, *Age of Alchemy* uses historical collections to offer a new approach to telling the story of alchemy and its impact on our world. The game unites the history of scientific inquiry with art history and material culture to tell vital stories of inspiration, transformation, and experimentation, with the potential to help bridge modern disciplinary divisions and recapture our shared histories.

1. *Alchemy as a Cross-Disciplinary Endeavor.*

Alchemists were not only chemical workers, but often authors, poets, composers, theorists, theologians, physicians, artists, and artisans. During the early modern period, artists and alchemists were both engaged in a search to understand the natural world. They also shared a practical relationship: many artists' goods were manufactured via alchemy, including pigments and dyes, effects in glassmaking and printmaking, and metal alloys for sculpture and ornament. Alchemical work encompassed technical skill, research and writing, experimental and creative labor. *Age of Alchemy* will present the diversity of alchemical pursuits and invite players to consider an early modern worldview in which science and artistic practice and theory are inextricably connected. One primary way in which this theme will be communicated is via the use of early modern paintings and prints as visual resources for developing the vivid 3D environments entered by players. By exploring alchemy through artworks, players will be primed to consider the close connections between diverse scientific and creative practices during the 1600s.

Artworks in CHF collections portray early modern alchemists at work and provide clues about the lived experience of alchemical experimentation. However, by nature of artistic license, these images also illustrate the widely varying perceptions of alchemical goals in the period, from affirmative admiration to satirical reproach. The scope of artists represented in CHF's collections, including Adriaen van de Venne (1589–1662), Thomas Wijck (1616–1677), and Richard Brakenburgh (1650–1702), demonstrate the rise and popularization of the alchemist scene as an artistic subject. The practices visualized include reading and writing, the study of globes and charts, as well as *chrysopoeia* (gold-making), *distillation* (reducing a substance to its essence), *iatrochemistry* (the making of chemical medicines), and other empirical processes.

Beyond the representation of tools and theories, *Age of Alchemy* will present alchemy more fully as a social enterprise. As revealed in the foundational research of Lloyd DeWitt and Lawrence Principe, artistic depictions of alchemists offer insight not only into the wide range of alchemical processes, but also the spectrum of opinions and attitudes that early modern people held about alchemy. Art-historical scholars such as Alison Kettering have recently begun to explore the

importance of early modern Netherlandish images that represent work, and their role as models of social mores and values. We will build on this research to develop storylines and environments that explore the position of the alchemist as an artisan, laborer, and creative worker.

2. *Diversity of Alchemy's Practitioners.*
A crucial aspect that has emerged in recent research into the history of alchemy is the diversity of its practitioners, philosophers, and patrons. *Age of Alchemy* places a young woman from a non-noble family at the center of its story, centering a non-elite practice of alchemy that draws on current humanities scholarship. The most public and well-known alchemical figures in the early modern era were royal patrons such as the Holy Roman Emperor and King of Bavaria Rudolf II (1552–1612), who drew leading alchemists to his court, or Queen Christina of Sweden (1626–1689), who kept a laboratory in her basement and experimented with courtly associates. Yet alchemy was not limited to elite spheres: it was practiced widely in humble contexts, such as the homes of village apothecaries or in private kitchens. In some cases, alchemical knowledge could also bring figures from society's periphery into the center. As one example, Daniel Jutte has recently explored the evidence for Jewish individuals who gained court entry specifically because of their alchemical expertise. Despite taking advantage of Jewish alchemists as "traders in clandestine knowledge," this clandestine aspect of alchemical practice also made them a target for suspicion and discrimination by Christians.

The new history of alchemy has also reconsidered artisans and craftspeople as critically engaged in alchemical pursuits, particularly in artisanal professions such as goldsmithing. In domestic or "household" alchemy, husbands, wives, and children worked side-by-side in the preparation of alchemical materials and in conducting experiments. By focusing on a merchant-class woman as the central character, *Age of Alchemy* will allow players to traverse the different levels of society in which alchemy operated, from humble artisanal shops to the royal courts. In this prototyping phase, we will refine our understanding of alchemical practitioners and theorists both in and outside the arena of the court and integrate representative personalities into our game narrative levels. Through the barriers that the central character Viola faces, players will gain insight into the classed, racialized, and gendered contexts for early modern alchemical practice.

3. *Women's Networks of Alchemical Practice.*
Current historical scholarship has led to a new understanding of women's contributions to alchemy as practitioners and theorists during the early modern era. Scholars including Meredith Ray, Jayne Archer, and Kathleen P. Long have explored how alchemical practices, by their nature of trade secrecy and clandestine knowledge, could generate intimate communities of knowledge in which women could converse with, debate, and collaborate with other women and men. This new research has surfaced numerous texts penned by female authors that range from practical alchemical recipes to theoretical cosmology, re-centering women's contributions to alchemical knowledge production. Like much scholarly research, however, the truth of women's participation in alchemical work has yet to filter into the popular imagination. *Age of Alchemy* will help to bridge this gap by offering an immersive and accessible story featuring a compelling female character engaged in experimental work.

As central character Viola advances in her journey in *Age of Alchemy,* players will learn about the challenges faced by female "adepts" during the 1600s, including the difficulty of gaining access to knowledge and entry into male-dominated spaces of chemical work. Players will also have the chance to experiment, interpret, negotiate, and create, demonstrating a range of both the limitations and achievements experienced by women in their historical context. Players will

encounter the gendered aspects of alchemical philosophical and spiritual symbolism itself in primary source texts. In conflict with older Aristotelian concepts that portrayed the male as the highest and most perfect form, many early modern alchemical treatises displayed uniquely fluid ideas of gender, arguing that the merging of male and female halves together was necessary to create a purified nature. Artists and manuscript illustrators adopted a wide variety of male and female forms to picture these processes.

In addition to metaphysical or symbolic imagery, many of the artworks in CHF's collections offer more straightforward depictions of women engaged in alchemical practice, from reading recipes to manipulating materials to supporting the household laboratory or workshop. At times, women also play the role of the voice of reason in satirical pictures depicting alchemy as a fool's errand. In *Age of Alchemy*, we will be able to nuance these naturalistic or humorous artistic portrayals of women's involvement in alchemy from a historically grounded perspective.

Comparable Projects and Unique Perspective of Age of Alchemy
There are a small number of humanities-based projects about the history of early modern science and alchemy, and even fewer of these projects have major digital elements. The *Making and Knowing Project*, directed by Pamela H. Smith (http://www.makingandknowing.org/), and the *Chymistry of Isaac Newton Project*, edited by William R. Newman (http://webapp1.dlib.indiana.edu/newton/) are two important digital humanities projects that are comparable to the goals for *Age of Alchemy*. The *Making and Knowing Project* exemplifies the diversity of approaches that can be employed to learn about early modern science. Specifically, *Making and Knowing*'s success in recreating early modern workshop circumstances and recipe experimentation for university students serves as a crucial example of the excitement generated by engaging in actual laboratory/workshop practice. The *Chymistry of Isaac Newton* is an example of a project that performs the important scholarly work of recovering alchemy as a normalized, accepted, and productive component of early modern scientific practice. Unlike these examples, *Age of Alchemy* seeks to reach beyond specialist and academic audiences to the non-specialist public through a focus on accessible narratives and immersive, engaging game play.

The Chemical Heritage Foundation as a Center for the Study of Alchemy
Age of Alchemy will act as the crucial next step in CHF's mission to advance as an interdisciplinary institution on the forefront of digital humanities initiatives and as an important center for the study of the history of alchemy. Alchemy continues to have a central place in the public imagination, as evidenced by the success of the *Harry Potter* series, among numerous other fictional interpretations of alchemy. New interpretive tools and strategies are critical in communicating the realities of alchemy's practice and its continued relevance to the shared histories of art, science and culture. Most recently, CHF's curatorial and research teams contributed to the creation of *Art and Alchemy: The Mystery of Transformation*, a landmark exhibition staged at the Museum Kunstpalast in Düsseldorf, Germany. Conceived in cooperation with the research group "Art and Knowledge in Pre-Modern Europe" at the Max Planck Institute for the History of Science in Berlin, this exhibition contained over 250 works and welcomed more than 40,000 visitors—vividly demonstrating alchemy's continued hold on the public imagination. In the winter of 2014, CHF debuted the exhibition *Books of Secrets: Writing and Reading Alchemy*. Rare alchemical manuscripts were displayed alongside paintings and prints depicting alchemists at work, as well as real tools and materials of the laboratory. In 2016 and 2017, CHF offered numerous public programs that merged alchemical histories with storytelling, games, and material culture, including our recent *Alchemical Storytime*, at which museum visitors were invited to hear CHF staff members tell the spectacular-but-true tales of early modern alchemists' adventures and misadventures.

In their exploration of the natural world and their desire to transform and perfect it, early modern alchemists shaped the practice of science, medicine, technology, and art. Their influence on our modern understanding of those fields continues to resonate. *Age of Alchemy* will bring this part of our collective past to light for public audiences.

3.C) Project format:

Age of Alchemy is envisioned as a first-person game that combines a deeply researched choice-based narrative with challenging puzzles and hands-on experimentation. Players will take on the role and perspective of an early modern individual—in the case of this prototype, a young woman—and navigate built 3-D environments drawn from CHF's art and manuscript collections. The emotional immediacy of first-person games allows *Age of Alchemy* to build empathy for past actors and understanding of the early modern mindset—one that believed in both empirical research and transmutative possibility. Individuals who engaged with alchemy were not fools or greedy charlatans; they were entrepreneurs, experimenters, teachers, and artists.

Players will enter early modern European society through the character of Viola, who, despite her talent, is barred by guild rules from inheriting her father's profession. Many trades and areas of study were closed to women, even those who gained skill and knowledge in family workshops. But alchemists did not belong to a guild or require a university degree to practice their art. Many women practiced alchemical techniques such as distillation at the domestic level, as hands-on knowledge about medicinal cures, dyes and color-making, and other necessary chemical products was widespread. By allowing players to enter the story through Viola, the game broadens audience perspectives regarding who was "allowed" access to scientific knowledge and expertise in the past, and whose contributions to natural knowledge have been either effaced or preserved.

The prototype will develop and test key game mechanics, to gauge how players interact with the game environment and experiences of **Explore**, **Interpret**, and **Experiment**. These dynamics will support our goal of presenting alchemy as a cross-disciplinary and creative pursuit. Alchemists engaged with art and literature, producing emblems, images, and allegorical prose; they pondered philosophical and cosmological truths and crafted essays on the alchemical nature of souls; they investigated the properties of matter and sought to better understand humankind's place in a diverse and complicated universe. Players, in the role of an aspiring alchemist, will experience the integration of pictures, symbols, tools, recipes, raw materials, theory, and manual skill in the quest for alchemical success. This artistic and experimental harmony of past alchemical practices offers players a unique counterpoint to contemporary disciplinary divisions between arts and humanities and STEM fields, and invites new dialogue on the longstanding importance of the humanities in shaping our perceptions of science.

In the **Explore** dynamic, players will enter the world of early modern alchemy through 3D recreations of environments inspired by images from CHF's art collections. This mechanic will immerse players in a new and challenging world and invite them to stretch their curiosity. Players will be able to navigate through a detailed early modern laboratory environment, collecting useful objects such as alembics and flasks, crucibles and tongs, manuscripts and globes. Players will be able to move around the room at their own leisure, finding useful laboratory equipment and observing their dimensionality and function in context.

In the **Interpret** dynamic, players will delve into the textual and visual materials that communicated alchemical ideas. This dynamic will demonstrate the importance of texts and images to alchemical work, and allow players to see the contexts and forms in which alchemical ideas were actually circulated. Using CHF's digitized library holdings, the game will incorporate rich historical visuals directly into the gameplay. Players will read digitized versions of primary historical alchemical texts or emblems from the early modern era. Players will be aided by prompts and game mechanics in order to translate the content into easily readable modern-English material that players will then rely on to conduct factual and historically accurate alchemical processes. Through these interpretation sequences, players will gain simple recipes and processes that are added to their workshop journal. This journal will also store hints and secrets, acting as both a reference and guide resource.

In the **Experiment** dynamic, players will test their newfound knowledge in the laboratory. This dynamic provides a playful look at the kinds of knowledge that can be gained by hands-on and empirical work. Players will control laboratory equipment and ingredients through tactile object interactions with their mobile device inputs. Through simple movements and actions such as tilting and shaking their device, players can work with common laboratory materials such as gold and mercury, distilled acids, and charcoal. They will experience first-hand the difficulty of controlling experiments and reacting when flames become too hot, or untempered glassware shatters.

Some of the narrative challenges and interactions that players will experience include finding both mentors and challengers within a pantheon of real historical experts; proving mastery over both symbols and experimental chemical work; and testing recipes from both elite alchemical compendiums and humbler recipe texts (for instance Sir Hugh Plat's 1602 *Delightes for Ladies*).

Successful Models

Age of Alchemy's design draws upon the use of exploration and experimentation in point and click adventure games to immerse players in fantastic worlds, a genre which has seen a recent resurgence with award winning titles such as *The Walking Dead, Gone Home, Firewatch,* and *1979 Revolution: Black Friday. Age of Alchemy* will adopt the hallmark design components of the adventure game genre, including inventory systems, puzzle design, and branching narrative to leverage the familiarity of this game genre to tell a new story about the precursors to modern science. *Age of Alchemy* also draws on recent innovations in mobile games such as *The Room* that explore the tactile potential of mobile device inputs. Furthermore, the popularity of *The Room*'s blending of stylized historical environments with uniquely tangible functionality and complex puzzle challenges suggests *Age of Alchemy* may appeal to similar audiences. The specific influences of these game titles on our design are described in further detail in our game design document.

Alchemy, as a game mechanic rather than a historical subject, appears frequently in popular commercial games, including the long-running *Atelier* series and the bestselling *The Elder Scrolls: Skyrim*. In most gaming usage, the term "alchemy" denotes "potion making," with fanciful ingredients ranging from "vampire dust" to "moon sugar." However, the popularity and ubiquity of this mechanic suggests that it may be both familiar and appealing within gaming communities. In our prototype phase, we will test the appeal of *Age of Alchemy*'s mechanics and their potential to reach a broad non-scholarly audience.

3.D) Audience and distribution:

The audience for the proposed prototype will primarily consist of playtesters as described in our evaluation plan, our Advisory Committee, and CHF staff. The proposed audience for the fully developed game, available for Android and iOS devices, will be refined as a result of playtesting and evaluation, but is envisioned as scientifically curious youth and adults (middle school and up). To reach this group, CHF will rely on our diverse array of regular public events, our extensive professional and academic networks, and other communication, marketing, and distribution channels successfully used by CHF to promote its public offerings:

- A short video featuring the finished game will be used in an extensive social media campaign to promote game distribution. CHF doubled our Facebook and Twitter followers in less than three years and currently have over 17,000 social media followers on Twitter, Facebook, LinkedIn, Instagram, and Pinterest, with an average of over 50,000 engagements (likes, replies, shares, and click-throughs) per year since 2014.
- *Age of Alchemy* will be promoted on CHF's website, which receives over 100,000 hits per month during the school year, using a model similar to that used for CHF's *Chemcrafter* app (http://assets.chemheritage.org/ChemCrafter/). Since its release in April 2014, *Chemcrafter* has been downloaded 851,000 times. Chemheritage.org is a trusted source for history of science information, with over 1.7 million visitors in the past fiscal year, more than double the number of visitors from just five years earlier.
- Promotional materials will be developed for CHF Museum visitors, both walk-in visitors and the teachers and students who participate in our museum tour program.
- *Age of Alchemy* will be advertised in CHF's quarterly publication *Distillations*, which has a distribution of over 17,000 readers.
- Additional opportunities for promoting *Age of Alchemy* lie in CHF's programmatic relationships with other Philadelphia-area science museums (such as the co-curated popular monthly *Science at Tap* series held at a local bar) and through CHF's role as a core organizer of the Philadelphia Science Festival.

3.E) Project evaluation:

Kate Haley Goldman will serve as the evaluation consultant for the *Age of Alchemy*, overseeing game conceptual and usability testing. The evaluation is designed to be both iterative and deeply collaborative, utilizing outside expertise to inform and supplement a strong internal team. Formative evaluation is especially critical for *Age of Alchemy* because it includes users in the development process, making the game more robust and interesting to players. This formative evaluation serves the team's iterative design process, aiding in determining conceptual clarity, players' motivations and behaviors, game mechanics, and structural feasibility. We seek to gather data about the following central design questions in this prototyping phase of development:

1) Does the narrative content and structure tell an interesting story?
2) Does the in-game hint system provide ample clues that create a balance between challenge and frustration?
3) Do interactions with laboratory equipment feel intuitive and tactile?
4) Is the process of translating information from source texts to modern English enjoyable?
5) Is there enough clear information available for players to successfully complete alchemical recipes?

Haley Goldman will work in tandem with CHF, EGS, and Gossamer Games to aid in the evaluation of the game and the interpretation of the results of these evaluations. Haley Goldman will design all

evaluation materials, including testing elements, protocols, and data collection sheets. In late February/early March 2018, the team will participate in a playtesting training, to allow EGS and Gossamer Games to continue monthly evaluation. Haley Goldman will lead the initial playtesting session, handing off this duty to EGS and Gossamer partners for the subsequent sessions. Haley Goldman will review the collected data and lead a debriefing session by phone after each session to help team members codify and interpret the testing session results.

During playtesting sessions, 12-20 participants with varying degrees of familiarity with video games will play through a section of the game's interactive digital storyboard that represents the same actions and interactions players will perform in the completed version of the game. We will hold these sessions with a variety of age groups, including middle and high school students, college students, and scientifically curious adults. We will also vary locations, including Drexel University's ExCITe Center (with its "captive audience" of over 40 students from various disciplines), CHF's popular onsite First Friday programs, and CHF's Science on Tap program. Sessions will last approximately 90 minutes, and small incentives may be offered to participants. At the conclusion of each playtesting session, participants will be given a survey that collects information on their background and their experience with the game. The playtesting survey, developed by Haley Goldman, will be structured to collect measurable data that addresses the core design questions in this phase of development. The evaluation will culminate in a compilation of lessons learned and recommendations for future development.

3.F) Rights, permissions, and licensing:

The bulk of the digital source material used to create *Age of Alchemy* consists of high-resolution images of CHF-owned manuscripts and artworks created by CHF staff, and raise no issues related to rights. CHF will retain intellectual property rights to the digital content created by CHF for *Age of Alchemy* and will own the executable when delivered. EGS will retain the rights to use the game for further research (i.e., non-commercial) and publishing purposes. Gossamer Games will retain the rights to the source code, with the exception of the CHF intellectual property.

For either the prototype or the full version of the game, if developed, CHF may choose to license a non-commercial recording of a musical score that appears in the 1618 alchemical work *Atalanta fugiens*, performed by the ensemble Les Canards Chantants and recorded at CHF. We do not anticipate the need to license images for the prototype. Gossamer Games will license professional software for use in development of the prototype, including Maya (3D design and animation software), Adobe Creative Cloud (illustration and image software), and Unity Pro (game development software). All costs for licensing are included in the budget.

3.G) Humanities Advisers:

<u>**CHF Key Staff & Project Team**</u>

Erin McLeary, Ph.D., CHF Museum Director, will serve as Project Director, guiding the internal CHF project team and aligning the overall timeline and deliverables for Drexel's Entrepreneurial Game Studio, Gossamer Games, and the CHF core team. McLeary brings extensive experience in exhibition and media project development.

Charles McGhee Hassrick, CHF Digital Projects Manager, directs and manages the CHF Museum's digital initiatives. He will be coordinating project timelines, milestones, meetings, and deliverables for EGS, Gossamer Games, the Advisory Committee, and the CHF team. He also

brings to the project his expertise in research and exhibit, content, and digital interactive development with many museums, including the Cleveland Museum of Natural History and the Museum of Science and Industry in Chicago.

Elisabeth Berry Drago, Ph.D., CHF Public History Fellow, is an art historian specializing in 17th-century Netherlandish art and has worked with the CHF collections in various capacities for the past four years. She is currently developing a book from her dissertation on 17th-century artist Thomas Wijck and what his paintings of alchemists communicate about the relationship of art and science. She will provide content expertise and additional project management support.

Nicole Cook, Ph.D., CHF Fine Art Researcher, conducts comprehensive research on CHF's art objects, in particular the collections of paintings and prints related to the history of alchemy and science. She is a specialist in early modern art and visual culture and also has experience with project management on digital collections and publication initiatives. She will provide content expertise and additional project management support.

Kate Haley Goldman, Independent Evaluator, will work with the CHF team to develop methodologies and to analyze and complete all testing and prototyping, bringing over 20 years of experience conducting evaluations in museums, cultural heritage institutions, nature centers, arts organizations, and other non-profits.

Humanities Advisers

Donna Bilak, Ph.D., Lecturer in History, Columbia University, brings a combination of scholarly and practical knowledge of alchemical practices. From 2014-2017, Bilak served as a postdoctoral fellow for the Columbia University-CHF joint "Making and Knowing" Project. Much of her research focuses on the *Atalanta fugiens*, an immersive and cross-disciplinary 17th-century manuscript containing poetry, alchemical allegory, and musical fugues that provides a valuable corollary for a modern multi-sensory interactive experience.

Lloyd DeWitt, Ph.D., Chief Curator and Irene Leache Curator of European Art, Chrysler Museum of Art, will bring expertise in early modern European art that will assist the game design team in interpreting and adapting visual assets. As a former CHF research fellow, DeWitt has deep knowledge of our collections. He also researches and publishes widely on Holland's Golden Age of painting, particularly Rembrandt and Jan Lievens, and on the relationship of alchemy and early modern art.

Michelle DiMeo, Ph.D., CHF Director of Digital Library Initiatives, oversees all aspects of digital collection development and is also a historian of early modern science and medicine. She is currently completing a monograph on Katherine Jones, Lady Ranelagh (1615-91), the older sister of the chemist Robert Boyle who had an active intellectual reputation and network of her own. DiMeo was chosen as an advisor for her expertise in early modern science and medicine and for her experience with digital projects.

Bruce Moran, Ph.D., Professor of History, University of Nevada, Reno, was a 2014–15 Cain Distinguished Fellow at CHF and will provide scholarly guidance on the practices of alchemists both inside and beyond the laboratory, their materials, equipment, and theoretical knowledge. A leading historian of science and material culture, Moran's landmark book *Distilling Knowledge* was among the first to fully demonstrate the deep and direct connections between alchemical practices and the emergence of formalized chemical science.

William Newman, Ph.D., Professor of History and Philosophy of Science, Indiana University Bloomington, will bring expertise in the cross-connected worlds of artisanal and alchemical practice and advise on ways to draw out those links for non-scholarly audiences. His scholarly and hands-on work in recreating period alchemical experiments has yielded new knowledge of

the discipline's practices and limitations, and offers a chance for creative input in developing game mechanics based on physical movement and gesture.

Lawrence Principe, Ph.D., Professor of History of Science and Technology, Johns Hopkins University, is a chemist and historian. His work explores the utility and realities of alchemical work in the laboratory. Through deep scholarship and demonstration, he has proved the possibilities of alchemical experimentation and their implications for the modern chemist and researcher. Principe has also worked closely with CHF's art collections and his body of work demonstrates the value of incorporating art and science studies.

David Schaller, Founder and Principal of Eduweb, designs award-winning digital learning games and interactives for museums around the country. He has also written many papers exploring digital media, games, and informal learning, including a chapter about digital learning games in the American Alliance of Museum's *The Digital Museum*. He has an M.A. in Geography and Museum Studies from the University of Minnesota and a B.A. in Humanities from Macalester College.

Pamela Smith, Ph.D., Professor of History, Columbia University, is the director of the *Making and Knowing Project*, a cooperative effort by Columbia University and CHF. The project attempts to access alchemical and artisanal knowledge via recreations in the modern-day laboratory. A historian of science and material culture, Smith's work explores alternative paths to textual knowledge through labor and artistic practice. This emphasis on embodied knowledge and experiential learning offer an innovative praxis that translates unexpectedly well to game theory.

James Voelkel, Ph.D., CHF Curator of Rare Books, Othmer Library of Chemical History and Resident Scholar in CHF's Beckman Center for the History of Chemistry, is a historian of early modern science. Voelkel is also the PI for an NEH sponsored foundation grant for a digital humanities project entitled "A Chymical Encyclopedia, Database, and Repository." He was chosen as an advisor for his experience in the history of early modern science and for his deep understanding of the rare books collection at CHF, which will serve as key assets for the game.

3.H) Digital Media Production Team:

Frank Lee, Ph.D., is Associate Professor of Digital Media at Drexel University and co-founder of Drexel's Game Design Program, ranked one of the top video game design programs in North America. Lee is Founding Director of the Entrepreneurial Game Studio.

Entrepreneurial Game Studio Project Manager (TBD) is responsible for administering the project and contract for the Entrepreneurial Game Studio and acts as a liaison between faculty, Gossamer Games, and the Chemical Heritage Foundation.

Thomas Sharpe is the Director of Gossamer Games and the studio's creative director responsible for the overall design, development, and creation of unique gameplay mechanics and game experiences.

Gossamer Games is an internationally-recognized independent game studio creating ambitious, aesthetic-driven experiences that explore games as an empathetic and expressive art form (http://gossamer-games.com/).

3.I) State of the project:

Over the last several years, CHF scholars have engaged in sustained research into the history of alchemy, producing a body of knowledge that will enrich and inform the project's narratives. CHF scholars have conducted extensive research into and analysis of our alchemical paintings collection and Fine Art Researcher Nicole Cook is currently undertaking a complete research survey of the CHF art collections. Public History Fellow and art historian Elisabeth Berry Drago recently organized detailed data gathered on 89 key alchemical paintings, which she then tagged and indexed with relevant subjects and themes. The data includes scholarly research, object definitions, and interconnections between objects and terms. As a team, we identified key alchemical processes, as well as period artifacts that provide deeper social-historical contexts to the goals of alchemists and the ways in which they worked. We also took high-quality images of the painting collection to allow for close study and to prepare for future game design phases.

Michelle DiMeo, CHF Director of Digital Library Initiatives, and James Voelkel, CHF Curator of Rare Books—both of whom will serve as project humanities advisors—have been deeply engaged in digitizing our rare book collections, which include illustrations and etchings from alchemical literary works. The digitization of this collection has enabled us to deepen the game experience into the books and artwork alchemists used in their own research and work, which were essential to alchemical practice and which are often represented in the paintings that form the game's visual world. DiMeo and Voelkel have also both contributed to the development of the game's humanities themes.

In preparation for the Prototyping Phase, CHF's team of content specialists have been working with Gossamer Games and the creative team at EGS to prepare the Design Document and to develop an engaging and historically rich storyline. Over the past year, the EGS team and Gossamer Games led CHF staff through a series of design sprints and charrettes with the goal of honing the game mechanics, defining humanities assets and content, and refining storylines and experience.

3.J) Work plan:

January 2018: Advisory Board, EGS, Gossamer, Evaluator, and CHF team meet to kick off the prototyping Phase: recap Phase I design work; discuss roles and project calendar; define user testing and prototyping roles and milestones; and finalize the design and humanities content of the first puzzle. EGS, Gossamer, and CHF develop paper prototype and recruitment plan for paper prototyping.

February 2018: The CHF team continues content development. Gossamer begins work on game design, functionality, and art, and finalizes plan for development and testing of interactive storyboards for five game levels and three interactive game mechanics. EGS, Gossamer, Evaluator, and CHF initiate paper prototyping with targeted audiences. Gossamer drafts the interactive storyboard for game Level 1. CHF, EGS, and Gossamer initiate regular, twice-monthly meetings to review progress and deliverables that will continue through the work period.

March 2018: EGS, Gossamer, and CHF attend playtesting training run by Evaluator. The CHF team continues content development and digitization of required CHF assets. Gossamer continues work on the interactive storyboard for game Level 1 and develops a draft of the first game mechanic, Experiment.

April 2018: CHF continues content development and digitization. Gossamer conducts user testing of the Experiment mechanic and the interactive storyboard for Level 1, recruiting participants from the Philadelphia Science Festival.

May 2018: Gossamer drafts the interactive storyboard for Level 2 of the game; tests the Experiment mechanic; and develops a second draft of the Experiment mechanic. Advisory Board, CHF, EGS, Gossamer, and Evaluator meet to review interactive storyboards for game Levels 1 and 2 and the Experiment mechanic. CHF scholars conduct user testing at the Historians of Netherlandish Art Quadrennial Conference.

June 2018: CHF adjusts content based on Advisory Board feedback. Gossamer initiates second draft of the interactive storyboard for game Level 2 and updates the Experiment mechanic according to testing results.

July 2018: Gossamer creates and tests an interactive storyboard for game Level 3 and creates the first draft of the second interactive mechanic, Interpret.

August 2018: CHF continues content development. Gossamer develops and tests second drafts of the interactive storyboard for game Level 3 and the Interpret mechanic.

September 2018: The Advisory Board, CHF team, Evaluator, Gossamer, and EGS meet to review progress. The CHF team continues to develop content as needed. Gossamer continues work on the second draft of the Interpretation mechanic and drafts and tests the interactive storyboard for game Level 4.

October 2018: Gossamer creates first draft of the third interactive mechanic, Explore, and develops and tests a second draft of the interactive storyboard for game Level 4.

November 2018: Gossamer creates the first draft of the interactive storyboard for game Level 5. Gossamer also continues work on and begins testing Explore mechanic.

December 2018: Gossamer completes and tests second drafts of the Explore mechanic and the interactive storyboard for Level 5. Advisory Committee, EGS, Gossamer, and CHF team conduct final playtesting. Gossamer prepares final prototyped version of the game.

3.K) Organization profile:

The Chemical Heritage Foundation's mission is to foster dialogue on science and technology in society. Through its Museum, Library, and Institute for Research, CHF positions itself as a respected and leading center for collecting, researching, and communicating the intricate relationship between science and society through historical inquiry and narrative. We ground our work in the idea that historical knowledge is crucial to a full appreciation of science and technology, the roles they play in our modern world, and the ways they will help shape the future. **The Entrepreneurial Game Studio** at Drexel University is a creative and experimental game development studio, incubator, and publisher focused on developing the next generation of leaders in the mobile game industry. **Gossamer Games** is an internationally-recognized independent game studio creating ambitious, aesthetic-driven experiences that explore games as an empathetic and expressive art form.

3. L) Fundraising plan:

In the budget presented with this application, the contribution of staff salaries and benefits relies on our operating budget, which draws from both endowment and from our annual fund. The Conference Center costs are an in-kind contribution. The remaining $15,718 contribution will be covered by a grant from an individual donor to CHF which supports collaborative, collections-based outreach and research projects. $10,000 from this same grant has already been used to support the conceptual work that has been done to date on *Age of Alchemy*.

When our prototype is developed, CHF will apply for next phase Production funding through NEH to fully produce and release the finalized game.

4. BIBLIOGRAPHY

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    Chemical History, The Chemical Heritage Foundation.

Humanities References - Secondary Sources
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    Winkel, Sanny de Zoete. *Class Distinctions: Dutch Painting in the Age of Rembrandt and
    Vermeer*. Exh. cat. Boston: Museum of Fine Arts, Boston, 2015.
Benedict, Barbara M. *Curiosity: A Cultural History of Early Modern Inquiry*. Chicago: University of
    Chicago Press, 2001.
Berger, Susanna. *The Art of Philosophy: Visual Thinking in Europe from the Late Renaissance to the
    Early Enlightenment*. Princeton: Princeton University Press, 2017.
Berry Drago, Elisabeth. *Thomas Wijck's Painted Alchemists at the Intersection of Art, Science, and
    Practice*. Ph.D. dissertation. University of Delaware, 2017.
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    Culture in Early Modernity). London and New York: Routledge, 2016.
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Godwin, Joscelyn, Ed and Translator. *Atalanta Fugiens: An Edition of the Emblems, Fugues and
    Epigrams*. Grand Rapids: Phanes Press, 1989.
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    Haven, CT: Yale University Press, 2014.
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    Publishing, 1997.
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Newman, William Royall. *Promethean Ambitions: Alchemy and the Quest to Perfect Nature*. Chicago: University of Chicago Press, 2004.

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Smith, Pamela H. *The Body of the Artisan: Art and Experience in the Scientific Revolution*. Chicago: University of Chicago Press, 2004.

Stolberg, Michael. *Uroscopy in Early Modern Europe*. Farnham, Surrey, England: Ashgate, 2015.

Stone, Harriet Amy. *Tables of Knowledge: Descartes in Vermeer's Studio*. Ithaca: Cornell University Press, 2006.

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Wamburg, Jacob, ed. *Art & Alchemy*. University of Copenhagen: Museum Tusculanum Press, 2006.

ERIN H. McLEARY
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Philadelphia, Pa., 19106
215.873.8230/emcleary@chemheritage.org

EXPERIENCE

Chemical Heritage Foundation, Philadelphia, Pa.
Director of the Museum   October 2014–present
Oversee all aspects of museum operations, including collection management and digitization, exhibition development, and visitor services; directly manage a staff of nine and indirectly manage frontline staff. Develop budgets, research funding opportunities, and coordinate grantwriting for museum projects. Conceptualize and coordinate collaborative projects with CHF's Institute for Research; work closely with CHF's manager of public programming to develop, fund, and implement public programs. Develop exhibition calendar, long-term collecting priorities, and audience development initiatives. Serve as a member of CHF's leadership team.

National Constitution Center, Philadelphia, Pa.
Exhibit Developer   May 2011–October 2014
Directed exhibition projects during all phases of development in close collaboration with in-house exhibition team. Conducted rigorous, detailed scholarly research to conceptualize and develop the exhibition story, worked with designers and museum registrar on physical presentation of all aspects of exhibition content, including graphic panels and labels, artifact display, and interactive components, and served as primary project manager for media projects. Solicited and coordinated content feedback from scholarly advisors, drafted exhibition scripts, and directed all editing and revision. Worked with other venues to modify or adapt content, layout, and marketing of traveling exhibitions to meet the NCC's mission and gallery requirements.

Center for Bioethics, University of Pennsylvania, Philadelphia, Pa.
Project Manager   September 2009–May 2011
Collaborated closely with primary investigator on a NIH grant-funded project examining the historical roots and current applications of forensic genetics technologies. Designed and administered surveys assessing current practices in forensic genetics, conducted historical, legal, and popular culture research tracing the development of specific technologies, developed content for and maintained project website, managed communications with project's international working group.

Chemical Heritage Foundation, Philadelphia, Pa.
Curator of Exhibitions; *Traveling Exhibits Coordinator*   November 2005–February 2009
Led interdisciplinary team of scientists, scholars, and collections staff to create permanent exhibition for new 6000-square-foot museum. Developed and implemented exhibition research and production schedules; supervised and coordinated consultants; conceptualized, researched, and wrote script and labels for approximately 800 objects (with one co-writer); served as curatorial representative on museum marketing team; coordinated long-term plan for changing exhibits gallery and developed related programming; wrote scripts and articles for CHF's podcast and general readership magazine.

Cornell University, Ithaca, N.Y.
Visiting Assistant Professor, Science and Technology Studies   August 2003–June 2004
Conceptualized, researched, wrote, and delivered lectures for two undergraduate lecture courses; researched, designed, and led course activities for two seminar courses of my own design; assessed student work; supervised teaching assistants; directed undergraduate honors thesis and supervised independent projects.

FREELANCE AND PROJECT WORK

Mütter Museum of the College of Physicians of Philadelphia, Philadelphia, Pa.
Guest Curator   August 2010–September 2013
With one co-curator and the museum director, developed interpretive approach and exhibition themes, researched themes and section content, contributed to preparation of two successful grant applications, and advised on exhibition strategy and evaluation for *Broken Bodies, Suffering Spirits*, an 800 square-foot permanent exhibition on the experience of injury, healing, and death in the Civil War.

Guest Curator; *Curatorial Researcher and Writer*   June 1997–August 2005

Conceptualized, researched, and wrote exhibition script and selected artifacts and images for three permanent exhibitions, including the exhibition which serves as an orientation to the entire museum; worked independently or in close coordination with museum director. Served as curatorial researcher and script writer for full gallery temporary exhibition.

American Philosophical Society Museum, Philadelphia, Pa.

Public Program Developer   February 2010–September 2011

Designed, researched, scripted, and created web content for *Ghost Gardens and Lost Landscapes*, a historical geocaching program that took participants on a tour of landscapes that no longer exist. Awarded a Heritage Philadelphia Program Independent Scholar grant for this project.

Associate Curator; *Research Curator*   July 2000–November 2009

Worked with highly collaborative team to lead exhibition research and planning: created research and production plans and schedules; conceptualized exhibition themes; conducted thematic, object, and image research; wrote, edited, and produced introductory texts and object labels; assisted with grant preparation.

EDUCATION

University of Pennsylvania, Philadelphia, Pa.
Ph.D. December 2001; M.A., 1997, History & Sociology of Science

Reed College, Portland, Ore.
B.A., 1994, Biology with a concentration in history

PUBLICATIONS

Peer Reviewed Articles:

"'A Track Across What is Now a Desert': A.H. Munsell's Quest for a System of Color" in
Anne Goodyear and Margaret Weitekamp, eds., *Analyzing Arts and Aesthetics* (Washington, D.C.:
Smithsonian Institution Scholarly Press, 2013): 40-55

"'Here Man Learns About Himself!' Visual Education and the Rise and Fall of the
American Museum of Health," *American Journal of Public Health* 102, no. 7 (July 2012): e27-e36.
(Co-authored with Elizabeth Toon.)

Multimedia Writing:

"The Curious Case of Body Snatching at Lebanon Cemetery," *Hidden City Philadelphia*, April 2015
(http://hiddencityphila.org/2015/04/the-curious-case-of-body-snatching-at-lebanon-cemetery/).

Contributor to National Constitution Center's *Constitution Daily* blog, 2011-2012.
Links available upon request.

Contributor to Chemical Heritage Foundation's *Distillations* podcast, 2008-2009.
Links available upon request.

"A Child's Garden of Chemistry," *Chemical Heritage* (26, no.1, 2008): 14-15.

"The Mütter Museum: Education, Preservation, and Commemoration," *Annals of Internal Medicine* 7,
no. 132 (April 4, 2000): 599-603.

PRESENTATIONS

Presented scholarly work at national conferences including the American Association of the History of Medicine, the History of Science Society, and the Medical Museums Association. Presented professional work at meetings of the National Council on Public History, the Mid-Atlantic Association of Liberal Arts Chemistry Teachers, and the Center for Conservation of Arts and Historic Artifacts.

CHARLES McGHEE HASSRICK

ACADEMIC DEGREES

MASTER OF FINE ARTS   2007
     School of the Art Institute of Chicago, Chicago, Illinois – MFA Designed Objects

MASTER OF URBAN PLANNING   1998
     University of Washington School of Urban Design and Planning, Seattle, WA

INTERNATIONAL POLICY CERTIFICATE   1997
     International School of Spatial Policy Studies, Groningen, The Netherlands

BACHELOR OF ARTS   1991
     Bowdoin College, Brunswick, ME – Biology/Classical Languages-Archaeology (*Cum Laude*)

SELECTED AWARDS AND HONORS

ASTC LEADING EDGE AWARD – *Science Storms* Exhibit at MSI (Team)   2011

AAM NAME AWARD FOR OVERALL EXCELLENCE – *Science Storms* Exhibit at MSI (Team)   2011

AAM GOLD MUSE AWARD **–** Create a Chemical Reaction Interactive, *Science Storms* at MSI (Team)   2011

AAM GOLD MUSE AWARD **–** Fire-Combustion Area of *Science Storms* at MSI (Team)   2011

AAM EXCELLENCE IN EXHIBITION AWARD: Special Achievement in Cooperative Learning **–**
     Skyline Exhibit at the Chicago Children's Museum (Team)   2010

MERIT SCHOLARSHIP **–** School of the Art Institute of Chicago   2004

PLANNING AWARD – Illinois Chapter of the American Planning Association (Team)   2004

HONOR AWARD – Illinois Chapter of the American Society of Landscape Architects (Team)   2003

PROFESSIONAL EXPERIENCE

DIGITAL PROJECTS MANAGER **–** Chemical Heritage Foundation, Philadelphia, PA.   2015 - Present
- Manage content development, research, design, evaluation, and fundraising for the Museum's digital initiatives, including –
  - **The Media Column** – redesigning the Museum's 18' digital centerpiece from a passive experience to an interactive exhibition about the history of science and materiality.
  - **Interactive Air Quality Visualization** – coordinating data and research from scientists, historians, advocacy groups, and others to create an interactive, time-based visualization of air quality from around the world.
  - **Beckman Online Exhibition/Game** – creating an online experience that invites users to explore and experiment with a collection of key 20th century scientific instruments.
  - **Age of Alchemy** – developing a video game that invites players to investigate symbology, metaphor, and allegory in Medieval alchemy and make connections to modern science.

SENIOR INTERPRETIVE PLANNER **–** Thinc Design, New York, NY.   2012 - 2015
- Directed exhibit development for Thinc Design's work on the new Cleveland Museum of Natural History, including galleries on the living planet, wildlife, astronomy and cosmology, Ohio, and early childhood discovery.
- Developed, wrote, and edited content associated with Climate+Change, a photographic exhibition about human ingenuity and adaptation to the challenges of climate change throughout the Hindu Kush Himalayan region.
- Lead the research and exhibit development efforts for the Royal Alberta Museum's new natural history galleries, including galleries on evolution, biodiversity, gems and minerals, invertebrates, and ancient landscapes.
- Collaborated with developers and designers in the creation of the Royal Alberta Museum's human history and children's galleries.

CHARLES McGHEE HASSRICK

FREELANCE EXHIBIT DEVELOPER **–** Chicago, IL.   2010 – 2012
- **Magical History Tour** – Conducted content research with Beatles collectors and historians and wrote exhibition copy for this Beatles memorabilia exhibition.
- **Art of Rock and Roll** – Collaborated with a team of other developers, designers, and media professionals to create sensory immersions into the inspirations for iconic rock and roll album covers.
- **MythBusters** – Responsible for exhibit development, creative direction, and copy writing for this traveling exhibit, collaborating with the MythBusters and the Discovery Channel.
- **Illinois Holocaust Museum** – Researched content and tested and developed interactives for the recent redesign of the Make a Difference Gallery.
- **Discovery Park of America** – Worked with Thinc Design to develop and design galleries on Native American history and alternative energy for this 100,000-square foot museum in western Tennessee.
- **Miami Science Museum** – Directed content and exhibit development for this new state-of-the-art science museum and aquarium. Facilitated creative workshops with Museum staff to focus and develop content and experiential concepts for three floors of interactive aquarium galleries and one interactive media-based gallery.
- **Sustainable Design Center** – Developed initial concept proposals and interactive exhibit elements for a hands-on experience of recent trends in residential sustainable design and technology.

SENIOR EXHIBIT DEVELOPER **–** Museum of Science & Industry, Chicago, IL.   2007 – 2010
- **Science Storms** – Collaborated as a member of the core creative team to design and develop *Science Storms*, *a* $38 million, 26,000 square foot exhibit that interprets the physics and chemistry of natural phenomena, including the curation of over 200 historic and contemporary artifacts and the creation of over 50 mechanical and media-based interactives, seven linear media pieces, and supporting graphics and labels.
- **Energy Planet** – Directed creative project team for an evolving, 8,000-square foot exhibit on the future of energy, which uses hands-on and media based interactives, advanced technologies and multi-player simulations.
- Worked directly with MSI's Development Department to raise $1.8 million for *Energy Planet's* renewable energy exhibits, outdoor energy "garden", high-efficiency lighting retrofit, and interpretive programs.
- Served as an Expert Advisor for the 30,000-square foot museum expansion to the Shanghai Energy Conservation Supervision Center as part of the Shanghai Expo 2010.

INSTRUCTOR – School of the Art Institute of Chicago – Chicago, IL.   2009
- *Digital Sculpture* – Co-instructed this course which links 3D design using Maya, Z-Brush, Rhino, and other modeling software to advanced 2D sculpting and 3D printing technologies, effectively transitioning students from virtual creation to cutting edge fabrication.

EXHIBIT DEVELOPER / PROTOTYPER **–** Chicago Children's Museum - Chicago, IL.   2004 – 2007
- Developed and tested exhibition concepts for a National Science Foundation funded exhibit, which uses an interactive construction experience to test theories on family learning, educational scaffolding and documentation.

CONSERVATION DESIGNER / PLANNER **–** Conservation Design Forum - Elmhurst, IL.   2001 – 2004
- Project Manager and creative lead for a variety of sustainable planning, policy and design projects, including:
    - **Route 47/Kishwaukee River Corridor Plan** – an award-winning participatory project that included sustainability indicators, GIS impact modeling, and conservation-based land use planning.
    - **Blackberry Creek Alternative Futures Analysis** – an award-winning project that designed and compared stormwater impacts of conservation-oriented development to those of conventional design.
    - **Menomonee Valley Sustainable Design Guidelines** – worked with the Rocky Mountain Institute and local leaders to develop sustainable guidelines for development in this industrial corridor in downtown Milwaukee.

CITY PLANNER **–** City of Klamath Falls, Klamath Falls, OR.   1998 - 2001
- Managed and co-directed the 1999 Land Use Alternatives Planning Project, completing visual preference survey, public hearings, GIS-based Draft Land Use Plan Map and Comprehensive Plan Policy Summary.
- Managed the City's Downtown Design Review Commission and the Downtown Urban Redevelopment Advisory Board, and initiated educational programs in historic preservation and downtown real estate.

Elisabeth Berry Drago, PhD   **Email:** eberrydrago@chemheritage.org
                                                   Phone: 215.873.8283

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SUMMARY OF QUALIFICATIONS

Art historian with extensive experience in developing engaging, interactive programming for a broad public. Specialist in the Early Modern Netherlands, the history of the print, and the interconnected developments of art and emerging science. Scholarly and popular writing skill-sets, with emphasis on narrative and opening dialogue. Strong commitment to increasing access to arts and culture across boundaries and borders.

EDUCATION

Ph.D   2016   University of Delaware, Department of Art History
                  Dissertation: "Thomas Wijck's Painted Alchemists at the Intersection of Art, Science, and Practice"

MA   2010   Temple University, Department of Art History
                  Thesis: "The Art and Science of Reading Faces: Physiognomic Theory and Hans Holbein the Younger"

BA   2004   State University of New York at Fredonia, Visual Arts & New Media (Fine Arts)

SELECTED EXPERIENCE

2015-Present   Public History Fellow, Chemical Heritage Foundation, Philadelphia PA

2014-2015   Museum Curatorial Assistant, Chemical Heritage Foundation, Philadelphia PA

2011-2012   Graduate Teaching Assistant, University of Delaware, Newark DE

2006-2013   Youth & Adult Studio Faculty, Fleisher Art Memorial, Philadelphia PA

2002-2003   Undergraduate Teaching Assistant, State University of New York at Fredonia, Fredonia NY

SELECTED FELLOWSHIPS AND HONORS

2015   *Summer Fellow*, Doing Digital History, Roy Rosenzweig Center for History and New Media
               George Mason University, Arlington VA

2014-2015   *Sewell C. Biggs Dissertation Award*, University of Delaware

2013-2014   *Allington Dissertation Fellow*, Beckman Center for the History of Chemistry
               Chemical Heritage Foundation, Philadelphia PA

2013   *Research Fellow*
               Consortium for the History of Science, Technology and Medicine, Philadelphia PA

2013   *Summer Fellow*, Delaware Public Humanities Institute (DELPHI)
                 Center for Material Culture Studies, University of Delaware

2012   *Summer Fellow*, Summer Institute in Technical Art History (SITAH)
                 Conservation Center, Institute of Fine Arts, New York University

PUBLICATIONS

2019   (Forthcoming) *Painted Alchemists: Early Modern Artistry and Experiment in the Work of Thomas Wijck*, Amsterdam Studies in the Dutch Golden Age, Amsterdam University Press.

2018   (Forthcoming) "Diverse Arts: A Spectrum of Early Modern Representations of Alchemy," in *A Cultural History of Chemistry in the Early Modern Age*, Editor Bruce T. Moran, Bloomsbury Academic.

2016   "Rebel Without a Chemistry Set," *Chemical Heritage Magazine*, Spring 2016.

2014   "Going to Pieces: A Detective Story," *Chemical Heritage Magazine*, Fall 2014/Winter 2015.

2013   "Double Vision: Thomas Wijck's *The Alchemist*," *Chemical Heritage Magazine*, Fall 2013/Winter 2014.

2012   "Surface and Substance: Physiognomic Theory and Hans Holbein's 'Pictures of Death,'" *Montage: Journal of the University of Iowa Art History Society*, Issue 6.

CONFERENCES AND SYMPOSIA

2018   Historians of Netherlandish Art International Interdisciplinary Conference, Ghent, Belgium
                 Co-Chair, "Early Modern Netherlandish Art and the Work of Science"

2016   University of Delaware: Art History at 50 Symposium, Newark DE
                 "Artists' Materials at the Interdisciplinary Edge"

2015   Making & Knowing Project (Columbia University), Reconstruction Workshop, Philadelphia PA
                 "A Digital Book: Conservation, Community and Social Media"

2014   Historians of Netherlandish Art International Interdisciplinary Conference, Boston MA
                 "Painting the Laboratory: Alchemical Pigments in the Art of Thomas Wijck"

2014   Boston University Annual Graduate Symposium, Boston MA
                 "Shadowed Spectatorship in the Photographic Nocturne, 1895-1910"

2012   University of Iowa Annual Graduate Symposium, Iowa City IA
                 "Surface and Substance: Physiognomic Theory and Hans Holbein's 'Pictures of Death'"

2012   University of Delaware Annual Graduate Student Symposium, Newark DE
                 "Folk Spirit and German Identity in Moritz von Schwind's *The Rose*"

NICOLE ELIZABETH COOK

The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702
ncook@chemheritage.org

(b) (6)

EDUCATION

Ph.D., University of Delaware   2016
- Dissertation: "Godefridus Schalcken (1643-1706): Desire and Intimate Display" (Committee Chair: Dr. H. Perry Chapman)

M.A., Tyler School of Art, Temple University   2010
- Thesis: "The First of Brave Men: Antiquity, Myth, and Masculinity in Hans Baldung Grien's *Hercules and Antaeus*" (Thesis Advisors: Dr. Ashley West and Dr. Tracy Cooper)

B.F.A., Moore College of Art & Design   2007
- Valedictorian: Double Major in Art History and 2-D Fine Arts (Painting and Printmaking)

OTHER PROFESSIONAL TRAINING

"Presenting and Researching Seventeenth-Century Dutch Art and History"   Summer 2013
Amsterdam-Maastricht Summer University (co-hosted by the Rijksmuseum, RKD, and CODART)

Folger Institute at the Folger Shakespeare Library, Washington D.C.   Fall 2012
Semester Seminar with Dr. Mario DiGangi (CUNY): "Sexuality, Theory, History, Drama"

CURATORIAL/MUSEUM EXPERIENCE

Fine Art Researcher, The Chemical Heritage Foundation, Philadelphia   August 2016–Present

Collections Project Coordinator (part-time), The Clay Studio, Philadelphia   August 2016–August 2017
- Position and project funded by the Luce Foundation for American Art.

The Leiden Collection, New York   2014–2016
- **Curatorial and Collections Management Assistant**, January 2015-August 2016
- **Curatorial Research Fellow**, July–December 2014

Spotlight Gallery Conversations Lecturer, Philadelphia Museum of Art   Fall 2014–Spring 2015

Art Collection Intern, Blank Rome LLP, Philadelphia   2008–2010

TEACHING EXPERIENCE (SELECTED)

Invited Speaker, Rowan University, Department of TV, Radio, and Film, "Horror Films"   Spring 2017

Instructor, Rutgers, The State University of New Jersey, Department of American Studies   Fall 2014

Teaching Assistant, University of Delaware, Department of Art History   2011–2014

Teaching Artist, Philadelphia Arts in Education Partnership Summer Program   Summer 2011

AWARDS, GRANTS AND FELLOWSHIPS

Sewell C. Biggs Dissertation Writing Award in Art History and Preservation Studies   2016
University of Delaware Graduate & Professional Education Professional Development Award   2015
Anna R. and Robert T. Silver Award for Excellence in Teaching, University of Delaware   2014
University of Delaware Competitive University Fellowship   2013–2014
Delaware Public Humanities Institute (DELPHI) Summer Fellowship   2013
Grant-in-Aid, Folger Institute at the Folger Shakespeare Library   2012

PUBLICATIONS

In Progress

Nocturnal Visual Culture in the Dutch Golden Age: Godefridus Schalcken and the Rise of Candlelight Painting (Amsterdam: Amsterdam University Press, expected 2018-19).

Chapters and Essays

"Eros, Intimität und Begehren in den Genrebildern von Godefridus Schalcken." In *Schalcken: Gemalte Verführung [Schalcken: Painted Seduction]*. Edited by Anja Sevcik. Exh. cat., Cologne, Wallraf-Richartz Museum. Stuttgart, 2015, 72-85.

"Eine alte Frau und ein junger Mann füttern einen Papagei," In *Schalcken: Gemalte Verführung [Schalcken: Painted Seduction]*. Edited by Anja Sevcik. Exh. cat., Cologne, Wallraf-Richartz Museum. Stuttgart, 2015, 151-54.

Book Reviews

Review of *Genre Imagery in Early Modern Northern Europe: New Perspectives*, ed. Arthur DiFuria (Routledge/Ashgate, 2016), in *Historians of Netherlandish Art Review of Books*, November 2016 (http://www.hnanews.org/hna/bookreview/current/16_Genre-Imagery1016.html).

LECTURES AND PAPERS (SELECTED)

"The Brush and The Candle: Nocturnal Viewing in Godefridus Schalcken's Late Self-Portraits,"- Session: "Before the Selfie," College Art Association, Washington D.C., 5 February 2016.

"From Amoris Causa to Pygmalion's Creative Dream – Godefridus Schalcken and Theories of Love and Art," International Conference, *Schalcken – Painted Seduction*, Wallraf-Richartz-Museum & Fondation Corboud, Cologne. 22 January 2016.

"Godefridus Schalcken's Seduction of the Beholder: Privileging the spectator's gaze in late seventeenth-century art," Arbeitskreis Niederländische Kunst- und Kulturgeschichte (ANKK) Conference, Bonn. 2 October 2015.

"Godfried Schalcken's Nocturnes: The Aesthetics and Erotics of Night in Seventeenth-Century Painting," 20th Annual Graduate Student Symposium on the History of Art, Philadelphia Museum of Art. 11 April 2015.

"Schalcken Plays Himself: Erotic Fantasy, Voyeurism, and the Artist's Studio," Sixteenth Century Society Conference, New Orleans. 18 October 2014.

"Illuminating Defacement: Graffiti in Pieter Saenredam's *Nave of the Buurkerk, Utrecht, from north to south*," Princeton University Art History & Archeology Graduate Student Conference. 9 April 2011.

SYMPOSIA AND PANELS

Panel co-organizer with Elisabeth Berry Drago, "Early Modern Netherlandish Art and the Work of Science," Historians of Netherlandish Art Conference (forthcoming, Ghent, May 2018).

Panel co-organizer with Sara Bordeaux, "Early Modern Netherlandish Artists and Their Money," The Sixteenth Century Society Conference, Bruges, August 2016.

PUBLIC TALKS

"Looking at Beauty and Seduction in Late Dutch Baroque Art," Osher Lifelong Learning Institute, University of Delaware. 12 March 2014.

PROFESSIONAL SERVICE

Vetting Committee, Material Culture Symposium for Emerging Scholars, U. of Delaware	2013–2014
Conference volunteer, Renaissance Society of America annual meeting	2012 & 2014
Co-Chair, University of Delaware Art History Graduate Student Lecture Series	2011–2012
Co-President, Tyler School of Art Graduate Art History Student Organization	2009
Secretary and Nominations Chair, Moore College of Art & Design Alumnae Board	2007–2010

LANGUAGES

Dutch, French, and German (advanced reading and intermediate speaking skills)

KATE HALEY GOLDMAN

(b) (6)
Kate@HaleyGoldman.com

HALEY GOLDMAN CONSULTING, PRINCIPAL
<div align="right">2015- Present</div>

Kate Haley Goldman is a researcher and evaluator. In the 20 years she has been in the field, she has conducted a wide-range of informal learning studies, often with a concentration on technology and the informal learner. She has directed projects both in the US and abroad, including mobile phones, multimedia installations, websites, gaming, augmented and mixed reality, and online learning.

AUDIENCE VIEWPOINTS CONSULTING, PRINCIPAL   2012-2015
DIRECTOR OF LEARNING RESEARCH AND EVALUATION, National Center for Interactive Learning at the Space Science Institute   2010-2012
SENIOR RESEARCH ASSOCIATE, Institute for Learning Innovation   2000-2010

SELECTED RECENT PROJECTS:

Lower East Side Tenement Museum, Digital Storytelling in Museums: A NEH-funded community of practice of museum educators, curators, and digital designers examining current affordances and obstacles in museum digital practices. http://digitalstorytellingtenement.weebly.com/eval.html (2016-Present)

Canadian Museum of Human Rights, Institutional Integrated Analytics: A whole-institution strategic planning effort to document data sources around the museum, identify gaps in indicators and information the museum is unable to analyze. Once the gaps were identified, we conducted workshops with leadership and stakeholders to prioritize objectives and align with key indicators. From those workshops, we developed a Strategic Roadmap detailing the information needed to monitor key indicators and the evaluation studies and staff capacity-building needed to carry out that system. (2015-2016)

Museum of Science Boston, Creating Museum Multimedia for Everyone: This benchmark NSF grant has produced universally-design multimedia prototypes, through a combination of design sprint, persona development, and iterative testing with visually impaired visitors. The goal was to design both process and prototypes for making traditionally inaccessible museum multimedia into content-rich experiences for a much broader public. (2012-2014)

Minnesota Historical Society, Play the Past iTouch game: A mobile role-playing game developed at the Minnesota Historical Society, the mobile devices make use of using QR codes to keep students engaging with the exhibit. Currently school-group based, this product is designed to inspire collaboration and critical thinking through historic context such as a Sod House, an Iron Mine, and a Trading Post. We studied impact of the game on how students related to the experiences from that time period. (2013-2014)

Co-PI of Open Exhibits (DRL-1010028; OpenExhibits.org) Directed applied research in this NSF grant to develop open-source modules for muli-touch tables. (2010-2014)

SELECTED CONFERENCE PRESENTATIONS:

- *Experiencing the Visitor Experience,* Museum Computer Network Workshop, November 2015 & 2016
- *Piloting and Implementing (Digital) Gallery Interpretation,* Museum Computer Network, November 2014
- *Nimble Evaluation (Evaluation 2.0)*, Visitor Studies Conference, July 2013
- *Gamification, Games and Museums*, American Affiliation of Museums, May 2013
- *Evaluating Games*, Museums and the Web, April 2012
- Invited Presentation*: Museums, Mobiles and Social Media*, Rutgers University, April 2010.
- *Evaluation Methods for Web 2.0*, Museums and the Web April 2009;
- Invited workshop: Learning in Museums 2008: *Technology, Interpretation and Learning in Museums. Evaluating Educational Technology.*
- *Web-Based Surveys: Pros and Cons*, Visitor Studies Annual Conference, August 2005
- Invited Speaker for International Workshop, Munich, Germany. *User or science oriented? On-line educational tools offered by science museums. Theoretical basics, methodical problems, practical examples*, April 2005
- *Exploring Motivational Factors and Visitor Satisfaction in On-line Museum Visits,* Museum and the Web Annual Conference, March- April 2004
- *Form and Function: Museums & Usability Strategies*, Museum Computer Network Annual Meeting, September 2002
- *What happens when there are too many visitors?* American Association of Museums Annual Meeting, May 1999
-

SELECTED PUBLICATIONS

- Schaller, D., & Haley Goldman, K. (2011). The Player's Voice - Using Evaluation to Bring the Player into the Development Process. In K. Beale (Ed.), *At Play: Games, Interaction and Learning*. Museums Etc: New York, New York.
- Haley Goldman, K. (2011) Understanding Adoption of Mobile Technology within Museums. In N. Proctor (Ed.), *Mobile Apps for Museums The AAM Guide to Planning and Strategy*. The AAM Press: Washington D.C.
- Katz, J., Haley Goldman, K., & Foutz, S.; (2010). Audience, Expectations, and Alignment. In J. Katz, W. Labar & E. Lynch (Eds.), *Creativity and Technology: Social Media, Mobiles & Museums*. Museums Etc: New York, New York
- Ellenbogen, K., Falk, J. & Haley Goldman, K. (2008). Understanding the Intersection of Museum Audience Motivations and Technology. In *Museum Informatics: People, Information, and Technology in Museums*. New York: Taylor & Francis.
- Haley Goldman, K. & Dierking, L. (2005). Setting a Course for Research in the Virtual Science Center. In L. Tan & R. Subramaniam (Eds.), *E-learning and the Virtual Science Center*. Idea Press: Hershey, PA.

EDUCATION:

Graduate work in Measurement, Statistics & Evaluation, College of Education, University of Maryland

B.S. in Anthropology from Bryn Mawr College 1993

Koobi Fora Field School / Harvard University, Nairobi, Kenya Summer 1992

May 18, 2017

Charles McGhee Hassrick
Digital Projects Manager
Chemical Heritage Foundation
315 Chestnut Street, Philadelphia, PA 19106

Dear Charles--

I am so pleased to write you this letter to confirm my commitment as advisor and evaluation consultant for your NEH prototype proposal submission for the *Age of Alchemy*, a historical role-playing puzzle. The game centers on a central concept of historians of science, medicine, and technology: how alchemy has had a significant impact on the larger cultural history, not just in Europe and United States, but thorough the world. Practiced by royalty, and peasants alike, the practice of alchemy fostered and supported the development of the enlightenment. Working with your project team, including partners: Drexel University, partners, Gossamer Games, and the advisory board, and the superb historical content and objects from the Chemical Heritage Foundation, I will be supervising evaluation throughout the course of the project, including both formative and summative evaluation. Specifically, the evaluation will provide iterative usability feedback for the further development of the *Age of Alchemy* to ensure this complex narrative puzzle game is playable, absorbing, and informative.

The humanities content and game structure of *Age of Alchemy* provides an ideal medium for demonstrating how game interaction can promote deeper understanding of the history of human culture. I have been evaluating museum technology for over twenty years, and I will be delighted to lend my expertise to this endeavor.

Sincerely,

Kate Haley Goldman
Haley Goldman Consulting
HaleyGoldman.com

CURRICULUM VITAE
DONNA BILAK
(t) (b) (6)   (e) dab2208@columbia.edu   (w) dbilakpraxis.com

Office: Columbia University - B206 The Heyman Center for the Humanities - 2960 Broadway MC: 5730 - New York NY 10027
Home: (b) (6)

Education

2003 – 2013
PhD, Cultural History
Bard Graduate Center: Decorative Arts, Design History, Material Culture – New York, USA
Dissertation: "The Chymical Cleric: John Allin, Puritan Alchemist in England and America (1623-1683)."
Supervisor: Peter N. Miller - External Examiner: Mordechai Feingold - Degree Conferred May 2014

2008
MPhil, Cultural History
Bard Graduate Center: Decorative Arts, Design History, Material Culture – New York, USA
Degree Conferred: May 2008

2002 – 2003
MA, History
York University – Toronto, Canada
Major Research Paper: "The Emergence of Botany and the Knowledge of Plants: Nature and Creation in the Sixteenth Century."
Supervisor: Richard C. Hoffmann - Second Reader: Thomas V. Cohen - Degree Conferred May 2004

2001 – 2002
Special Student, Masters Programme History
York University – Toronto, Canada

1991 – 1994
Jewellery Arts Diploma
George Brown College of Applied Arts and Technology – Toronto, Canada
Gold- and Metalsmithing, Gemmology, Metallurgy, Enamelling, Jewellery Design - Degree Conferred May 1994

Employment

2017 – 2018 The Italian Academy for Advanced Studies Fellow – Columbia University
2014 – 2017 History of Science and Technology Postdoctoral Fellow, "The Making and Knowing Project" – Columbia University, Department of History
2013 – 2014 Edelstein Postdoctoral Fellow – Chemical Heritage Foundation
2001 – 2017 Antique Jewelry and Art Conference (New York) – Jewelry industry educator for history of jewelry design and technology
2001 – 2008 Royal Ontario Museum (Toronto) – ROMLife Public Lecture Series Course Director and ROMLife Program Co-ordinator
1994 – 2000 Jewelry Industry Production (Toronto) – Freelance designer; wax model maker; private commissions. 1998-1999 jewelry designer for Design Model Services/DMS Group (firm specializing in wax jewelry models and designs for international gold, platinum, and gemstone jewelry manufacturers); 1997-1998 provided jewelry designs, wax jewelry models, and retail services at Secrett Jewel Salon; 1996-1997 created and produced jewelry designs and wax jewelry models for Dianna Rhodes Accessories (firm specializing in electroformed jewelry).

Fellowships

2017 – 2019 Visiting Scholar – Brown University, History Department
- Two-year appointment renewed annually in support for the development of "Project Atalanta," the digital edition of *Atalanta fugiens* (1618) based on Dr. Bilak's research and funded by the Andrew W. Mellon Digital Scholarship Initiative.

2017 – 2018 The Italian Academy for Advanced Studies, "'Catch Me If You Can': Ludic Humanism and Michael Maier's *Atalanta fugiens* (1618)" – Columbia University
2014 – 2017 History of Science and Technology Postdoctoral Fellow, "The Making and Knowing Project" – Columbia University, Department of History
2013 – 2014 Edelstein Postdoctoral Fellow, "The Allegorical Laboratory: Michael Maier's Alchemical Emblem Book *Atalanta fugiens* (1618)" – Chemical Heritage Foundation
2013 Dibner Research Fellow in the History of Science and Technology, "The Sight and Sound of Early Modern Alchemy: Michael Maier's *Atalanta fugiens* (1618)" – The Huntington Library
2012 Visiting Scholar, Department of Cultural Studies – National University of Kyiv-Mohyla Academy, Ukraine
- Course Director (MA seminar): "Cultural History of Computers and Information Technology."
- Workshop Director (PhD students): "Doing History in the Digital Age: Research, Methodology, Interpretation."

Grants and Awards

2016   Andrew W. Mellon Digital Scholarship Initiative – Brown University
- Awarded for "Project Atalanta," the development and publication of a multimedia digital edition of an alchemical emblem book set to music, *Atalanta fugiens* (1618) at Brown University. Co-edited with Tara Nummedal (Brown, History Department) and in collaboration with musicologist Dr. Robin Bier (Director, solo-voice ensemble Les Canards Chantants) and Dr. Loren Ludwig (Director, LesStrange Viols).

2015   Betty Irene Moore Library Fund – Chemical Heritage Foundation
- Awarded to fund the workshop, "Interplay: Rethinking Music, Mathematics, and Alchemical Praxis in the *Atalanta fugiens* (1618)."

2014   American Members of CINOA Award for Outstanding Dissertation – Bard Graduate Center (BGC)
- Awarded for "The Chymical Cleric: John Allin, Puritan Alchemist in England and America (1623-1683)."

2012   Canadian Institute of Ukrainian Studies, Stelmaschuk Extension Education Endowment Fund – University of Alberta

2011 – 2012   Bard Graduate Center Dissertation Writing Up Award

2010 – 2011   Bard Graduate Center 4th Year Dissertation Writing Award

2003 – 2008   Bard Graduate Center Fellowship

Publications (select)

Peer Reviewed   Article: "The Making and Knowing Project: Reflections, Methods, and New Directions." Co-authored with Pamela H. Smith, Joel Klein, and Jenny Boulboullé.
West 86th: A Journal of Decorative Arts, Design History, and Material Culture, Vol. 23, No.1 (2016): 35-55.

Entry: "Allin, John (1623-1683), non-conformist minister and alchemist."
Oxford Dictionary of National Biography. Published September 2014.

Article: "Alchemy and the End Times: Revelations from the Laboratory and Library of John Allin, Puritan Alchemist (1623-1683)."
Ambix: The Journal of the Society for the History of Alchemy and Chemistry, Vol. 60, No.4 (November 2013): 390-414. Special Issue, "Alchemy and Religion in Christian Europe."

Book Proposal *"Alchemy in Code": A critical digital edition of Michael Maier's Atalanta fugiens (1618) with scholarly commentary.* Co-edited with Tara Nummedal. University of Chicago Press (under review). Projected Completion: 2019.

CHF Workshops and Museum Outreach

2015 Oct –   Workshop Director: "Material Conversations: Matter and Methodology in History of Science Research and
2016 May   Pedagogy"
- Initiated, designed, organized and moderated a monthly discussion group that convened fellows from CHF's Beckman Center and Institute for Research with representatives from CHF's museum and library to engage in debate and exploration around the methodology of material culture in history of science projects and practices. Workshops included handling sessions with objects and instruments from CHF's museum collections and library sessions with archival and rare book materials to advance material literacy among CHF fellows.

2015 Mar   Workshop Director: "Interplay: Rethinking Music, Mathematics, and Alchemical Praxis in the *Atalanta fugiens* (1618)"
- Two-day international multi-disciplinary workshop sponsored by the Chemical Heritage Foundation that convened twenty international scholars from musicology, mathematics, classics, religious studies, and history of science together with rare book curators to probe and explore Donna Bilak's research about Michael Maier's alchemical emblem book *Atalanta fugiens* as a text to be read, performed, and used as a game based on its hidden mathematical elements.
- Initiated, designed and co-organized with Ronald Brashear (Arnold Thackray Director of the Othmer Library and Director of the Beckman Center), presented in collaboration with Dr. Robin Bier and Les Canards Chantants.

2015 Apr   Event: "The Alchemist's Cookbook." CHF First Friday Event Co-ordinator, co-presented with Ryan Whibbs, Professor, Culinary Arts School at George Brown College of Applied Arts and Technology.
Presented in conjunction with the CHF feature exhibit *Books of Secrets: Writing and Reading Alchemy*.

2014 Apr   Event: "Night at the Alchemical Laboratory." CHF First Friday Event Co-ordinator, co-presented with Elisabeth Berry Drago, CHF Fellow.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

DEPARTMENT OF HISTORY

Donna Bilak, PhD
Lecturer in History, Department of History
Columbia-CHF Scholar-The Making and Knowing Project
Columbia University
The Heyman Center for the Humanities
2960 Broadway MC: 5730
New York, NY 10027

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

22 May 2017

Dear Dr. McLeary,

I am pleased to commit to an advisory relationship with The Chemical Heritage
Foundation (CHF) for their *Age of Alchemy* Game Project and in support of their
application for a Digital Projects for the Public Prototyping grant from the National
Endowment for the Humanities (NEH). This project will be a valuable contribution to
CHF's continuing efforts to interpret and make accessible their artworks and manuscripts
related to the history of early modern alchemy and science for broader public audiences.

I began my relationship with CHF in 2013-2014 when I was the Edelstein Postdoctoral
Fellow for my research project, "The Allegorical Laboratory: Michael Maier's
Alchemical Emblem Book *Atalanta fugiens* (1618)." My research shows that Maier's
philosophico-alchemical program in *Atalanta fugiens* conceals a mathematical puzzle that
is revealed to the erudite reader upon detecting clues embedded in its music, images, and
text, transforming its reading experience into an interactive game predicated on the
reader's use of imagination. My research as a CHF Fellow was advanced through a two-
day international multi-disciplinary workshop sponsored by the Chemical Heritage
Foundation in March 2015, "Interplay: Rethinking Music, Mathematics, and Alchemical
Praxis in the *Atalanta fugiens* (1618)." This workshop was co-organized by Ronald
Brashear, and convened twenty international scholars from musicology, mathematics,
classics, religious studies, and history of science together with rare book curators to probe
and explore my research on *Atalanta fugiens* .

Since then, I have received a 2017-18 Fellowship at The Italian Academy for Advanced
Studies (Columbia University) to continue my research on *Atalanta fugiens*. In addition

to this, I am also co-editing with Tara Nummedal (Brown University) a critical digital edition of the book with a set of integrated scholarly essays; this collaborative project involves experts from music, mathematics, digital humanities, and the histories of science and the book, and is supported by the Mellon-funded Digital Publishing Initiative at Brown University.

My collaborative work with CHF continued through 2014-17, when I was the Columbia-CHF Scholar on The Making and Knowing Project at Columbia University, a five-year initiative under the direction of Pamela H. Smith to create an open-access critical digital edition and English translation of a late sixteenth-century French manuscript compilation of artisanal recipes of a proto-scientific nature, held by the Bibliothèque nationale de France (BnF Ms. Fr. 640). During this period, my role at CHF included collaborating on such museum public outreach First Friday programs as: "The Alchemist's Cookbook" (April 2015) co-presented with Ryan Whibbs (Professor, Culinary Arts School at George Brown College of Applied Arts and Technology), and presented in conjunction with the CHF feature exhibit *Books of Secrets: Writing and Reading Alchemy*; and "Night at the Alchemical Laboratory" (April 2014), co-presented with Elisabeth Berry Drago, CHF Fellow.

From October 2015 to May 2016, I also led a monthly discussion group at CHF, "Material Conversations: Matter and Methodology in History of Science Research and Pedagogy," which convened fellows from CHF's Beckman Center and Institute for Research with representatives from CHF's museum and library to engage in debate and exploration around the methodology of material culture in history of science projects and practices. This reading group included handling sessions with objects and instruments from CHF's museum collections and library sessions with archival and rare book materials to advance material literacy among CHF fellows.

In closing, please accept this letter as proof of my intent to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to fulfilling my capacity as an advisor, should your NEH application be accepted.

Sincerely,

Donna Bilak, PhD

Lloyd DeWitt

• h (b) (6)   w 757 965 2048 m (b) (6)   • ldewitt@chrysler.org

EMPLOYMENT

IRENE LEACH CURATOR OF EUROPEAN ART AND CHIEF CURATOR   2016-PRESENT
CHRYSLER MUSEUM OF ART, NORFOLK VA

Exhibitions :   •*The Agrarian Ideal,* October 2016 – January 2017
                    •*The Paris of Toulouse-Lautrec* March – June 2017

CURATOR OF EUROPEAN ART   2011- 2016
ART GALLERY OF ONTARIO, TORONTO, CANADA
Exhibitions: • *Vilhelm Hammershøi: Painter of Light and Silence*, April 15– July 3, 2016
                    • *J. M. W. Turner: Painting Set Free*, October 31, 2015- January 30, 2016
                    • *Michelangelo: Quest for Genius,* October 17, 2014 – January 11, 2015
                    • AGO Kids' Gallery installations December 2013 – December 2016

Spearheaded deaccessioning initiative and policy revision. Acting Curator of African and Oceanic
Art and Manager of AGO Library and Archives with staff of four librarians and archivist

ASSOCIATE CURATOR, JOHN G. JOHNSON COLLECTION   2003-2011
CURATOR OF DUTCH AND FLEMISH PAINTINGS BEFORE 1900
PHILADELPHIA MUSEUM OF ART

Exhibitions   • *Dutch Treat: Ten Paintings by Gerrit Dou*, November 2011 – December 2011
                   • *Rembrandt and the Face of Jesus*, August 2011 – October 2011
                   • *Jacob van Ruisdael, Dutch Master of Landscape*, 2005-2006

VISITING PROFESSOR   2009
UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA

MUSEUM FELLOW, DEPARTMENT OF ART HISTORY AND ARCHAEOLOGY   2002-2003
UNIVERSITY OF MARYLAND, COLLEGE PARK
• curated Dutch paintings in 2004 exhibition *Manet and the Sea*

ADJUNCT INSTRUCTOR   2001-2002
URSINUS COLLEGE, COLLEGEVILLE, PA

PRICE FELLOW   2001-2002
CHEMICAL HERITAGE FOUNDATION, PHILADELPHIA

ADJUNCT INSTRUCTOR   2000-2001
LASALLE UNIVERSITY, PHILADELPHIA

EDUCATION

CERTIFICATE PROGRAM IN NON-PROFIT MANAGEMENT   2012- PRESENT
CHANG SCHOOL, RYERSON UNIVERSITY, TORONTO

PHD, ART HISTORY, UNIVERSITY OF MARYLAND, COLLEGE PARK   1996-2006
Dissertation: *Evolution and Ambition in the Career of Jan Lievens 1607-1674*

MA, ART HISTORY, UNIVERSITY OF MASSACHUSETTS, AMHERST   1991-1993
Major Area: Northern Renaissance and Baroque Art•Minor Area: Italian Renaissance and
Baroque Art

BA, HONOURS, FINE ART   1986-1990
UNIVERSITY OF GUELPH, ONTARIO, CANADA

SELECTED PUBLICATIONS

"A Newly discovered *Head of John the Baptist* by Rembrandt's Studio," *Rembrandt and his
Circle: Insights and Discoveries,* ed. Stephanie Dickey, Amsterdam: Amsterdam University Press,
forthcoming (2017)

"From Italy to Holland: Caravaggio's Darkness and Light come North," *Illuminations: Italian
Baroque Paintings in Canadian Collections*. Exh. Cat. Hamilton: Art Gallery of Hamilton, 2015

"'They leave us as they find us, they never elevate,' John G. Johnson and the Dutch Masters,"
*Holland's Golden Age in America: Collecting the Art of Rembrandt, Vermeer and Hals.
Symposium Papers presented at the Center for the History of Collecting in America*. New York:
Frick Collection, 2014

 "The Heads of Christ, a Technical Survey," with Mark Tucker and Ken Sutherland, and "Testing
Tradition against Nature: Rembrandt's Radical new Image of Jesus," in *Rembrandt and the Face
of Jesus.* ed. Lloyd DeWitt. Exh. Cat. Philadelphia: Philadelphia Museum of Art, 2011

"The Guiding Illusions of the Morrison Triptych," with Mark Tucker in *Push me Pull you: Art and
Devotional interaction in Medieval and Early Modern Europe*. eds. Laura Gelfand and Sarah
Blick. Leiden: E. J. Brill, 2011

 "Personality as the key to the career of Jan Lievens," and catalogue entries in *Jan Lievens: A
Dutch master rediscovered.* ed. Arthur K. Wheelock. Exh. Cat. Washington, D.C.: National
Gallery of Art, 2008

"Manet and the Dutch Marine Tradition," *Manet and the Sea.* ed. Joseph Rishel. Exh. Cat.
Philadelphia: Philadelphia Museum of Art, 2004

*Transmutations: Alchemy in Art, Selections from the Eddleman and Fisher Collections at the
Chemical Heritage Foundation,* with Lawrence Principe. Philadelphia: Chemical Heritage
Foundation, 2002

AWARDS

University of Pennsylvania, Penn Humanities Forum Regional Fellow, 2008-2009

National Endowment for the Humanities, Exhibition Planning Grant for *Fortune and Folly:
Alchemy in Northern European Art*, in collaboration with the Chemical Heritage Foundation, 2007

Samuel H. Kress Foundation, Travel Fellowship in the History of Art, 2003

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

June 2, 2017

Dear Dr. McLeary,

I am pleased to commit to an advisory relationship with The Chemical Heritage Foundation (CHF) under the *Age of Alchemy* Game Project, in support of your application for a Digital Projects for the Public Prototyping Grant from the National Endowment for the Humanities. This project will be a valuable contribution to CHF's continuing efforts to interpret their significant holdings of artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

I began my relationship with CHF in 2001-2002 when I served as the Charles C. Price Fellow, a joint curatorial fellowship shared between CHF and The Philadelphia Museum of Art. At that time, CHF had newly acquired the Eddleman and Fisher collections of early modern paintings portraying alchemists and early scientists and I undertook a comprehensive research campaign of the collections. I also collaborated with Lawrence Principe, Professor in the Department of Science and Technology at John Hopkins University, on a catalogue of selected works in the collection titled *Transmutations: Alchemy in Art*, which was published in 2002 and supported by The Samuel H. Kress Foundation and the Fisher Found of The Pittsburgh Foundation. Through these experiences, I gained deep insight into the CHF collections and I am excited to revisit their potential as teaching tools for public audiences.

In closing, please accept this letter as proof of my intent to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to fulfilling my capacity as an advisor, should your NEH application be accepted.

Sincerely,

Dr. Lloyd DeWitt
Chief Curator and Irene Leache Curator of European Art
ldewitt@chrysler.org
757 965 2048

Michelle DiMeo, Ph.D.
Director of Digital Library Initiatives

Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

Phone: 215-873-8214
Email: mdimeo@chemheritage.org

RELEVANT EMPLOYMENT

Director of Digital Library Initiatives, Othmer Library of Chemical History   (July 2016 – Present)
Curator of Digital Collections, Othmer Library of Chemical History   (Sep. 2014 – June 2016)
Chemical Heritage Foundation. Philadelphia, PA.

- Overseeing installation of first institution-wide DAMS and digital repository using Hydra Repository
- Created and managing a Digital Collections team of 5 staff members: Applications Developers, Metadata Librarian, Systems Administrator, Collections Photographer
- Wrote policies to provide strategy for, and to sustain the management of, digital assets from CHF's diverse collections
- Provided technical guidance and managed budget for installation of 2D and 3D object photography studios

S. Gordon Castigliano Director of Digital Library Initiatives, Historical Medical Library
The College of Physicians of Philadelphia. Philadelphia, PA.   (Sep. 2012 - Sep. 2014)

- Initiated creation of College of Physicians of Philadelphia's Digital Library: www.cppdigitallibrary.org (Curated the selection of nearly 1,000 images and exhibitions using Omeka)
- Served as the College's representative on the Medical Heritage Library's Governance Group
- Created and managed digital library internship program: supervised 1-3 interns every semester
- Negotiated and managed contracts with Internet Archive and HathiTrust to ingest digitized content

Marion L. Brittain Post-doctoral Fellow, School of Literature, Communication and Culture
Georgia Institute of Technology. Atlanta, GA   (Aug. 2011 - Aug. 2012)

- Completed post-doctoral courses in "Digital Pedagogy" and "Technical Communication"
- Taught 3/3 load per semester of the 300-level course "Technical Communication." Topics included Web Design, Information Architecture, Usability Testing, and Plain Language

Graduate Programme Coordinator for M.A. in Historical and Sustainable Architecture
NYU in London. London, England.   (Aug. 2010 - Aug. 2011)

- Pioneered first year of M.A. as only NYU staff member permanently located in London
- Supervised 8 part-time faculty members and mentored 12 graduate students
- Assisted in curriculum development and strategic planning for 2012-13 academic year

EDUCATION

Certificate in Curation & Management of Digital Assets, University of Maryland.   (2015 - 2016)

Ph.D. in English and History, University of Warwick, UK.   (2005 - 2010)
Dissertation: "Katherine Jones, Lady Ranelagh: Science & Medicine in a 17th-Century Englishwoman's Writing"

M.A. in English, University of Warwick, UK. Graduated with Distinction (Honors).   (2004 - 2005)
Concentration: Renaissance and Seventeenth-Century Studies

B.A. in English, Roosevelt University. Chicago, IL. University & Departmental Honors   (1998 - 2002)

SELECT FELLOWSHIPS

Folger Shakespeare Library, Short-Term Research Fellowship   Summer 2016
University of Maryland, Tuition waiver for inaugural year of CMDA Certificate   2015-2016
    (UMD tuition funding provided through an IMLS Laura Bush 21st Century grant)
Warwick Postgraduate Research Fellowship, University of Warwick   2006-2008
Making Publics 1500-1700 (MaPs) Summer Seminar Fellow, McGill University   Summer 2007

SELECT GRANTS AND AWARDS

- IMLS Sparks! Grant for Libraries Award, $23,513 for "Local Caching for External Linked Data Authorities in Hydra". (2017) SP-02-16-0014-16.
- Medical Library Project Award, $15,000 for "Emerging Roles for Historical Medical Libraries: Value in the Digital Age" from NN/LM Middle Atlantic Region. (2013-2014).
- NEH Humanities Collections and Reference Resources Award, $195,430 for "Expanding the Medical Heritage Library" with sub-recipients Cushing & Whitney Medical Library of Yale University and Columbia University Libraries (2012-2014). PW-51014-12.
- US/Warwick Interchange Annual Conference Award, £5,000 from American Study and Student Exchange Committee, University of Warwick (2007)

SELECT RECENT PUBLICATIONS

"Communicating Medical Recipes: Robert Boyle's Genre and Rhetorical Strategies for Print" in *The Palgrave Handbook of Early Modern Literature and Science,* eds. Howard Marchitello and Evelyn Tribble (Palgrave, 2017), pp. 209-228.

(co-editor with Jeffrey Reznick) "Emerging Roles for Historical Medical Libraries: Value in the Digital Age" Special Issue of *RBM: A Journal of Rare Books, Manuscripts and Cultural Heritage,* 15.2 (Nov. 2014)

"Lady Ranelagh's Book of Kitchen Physick?: Reattributing Authorship for Wellcome MS 1340". *Huntington Library Quarterly*, 77.3 (Autumn 2014), 331-46.

SELECT CONFERENCE PRESENTATIONS

"Digital Collection Development: Moving from Short-Term Solutions to Long-Term Strategies" at *Building Philadelphia-Area Digital Collections*. PACSCL, University of Pennsylvania. Philadelphia, PA. January 2016.

Chair of panel "Big Data and the Medical Humanities" at *American Association for the History of Medicine Annual Convention*. Yale University. New Haven, CT. April 2015.

"Early Modern Recipe Books in the History of Medicine Classroom: Possibilities and Limitations of Digital Surrogates" at *Women's History in the Digital World*. Bryn Mawr College. Philadelphia, PA. Forthcoming: May 2015.

"Updates on the Medical Heritage Library" at *Archivists and Librarians in the History of the Health Sciences Annual Meeting*. American College of Surgeons. Chicago, IL. May 2014.

SERVICE AND CONSULTING

- Member of the Technology Committee for the History of Science Society (2016-Present)
- Governance Group Member (2012-2014) and Scholarly Advisory Committee Member (2014-Present). Medical Heritage Library. www.medicalheritage.org
- Advisor. "History of Medicine in 50 Objects" web exhibition by the Mütter Museum (2014-2016)
- Member of Review Panel. National Endowment for the Humanities (NEH), Division of Preservation and Access, panel for "History of Science, Medicine and Technology" sub-set of Humanities Collections and References Resources program (2013)

Chemical Heritage Foundation
LIBRARY • MUSEUM • CENTER FOR SCHOLARS

315 Chestnut Street | Philadelphia PA 19106-2702 | 215.925.2222 phone | 215.925.1954 fax
chemheritage.org

Dr. Michelle DiMeo
Director of Digital Library Initiatives
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

Dr. Erin McLeary, Museum Director
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

June 1, 2017

Dear Dr. McLeary,

I am pleased to submit this letter of support for the Chemical Heritage Foundation's application for funding from the National Endowment for the Humanities' Digital Projects for the Public program for CHF's *Age of Alchemy* game. This letter also represents my commitment to serve as a humanities advisor for the *Age of Alchemy* Game Project. This project will be a valuable contribution to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

I am a historian of early modern science and medicine and I hold a Ph.D. from the University of Warwick, where I completed a dissertation on Katherine Jones, Lady Ranelagh (1615-91), the older sister of the chemist Robert Boyle. My recent publications include the co-edited collection *Reading and Writing Recipe Books 1550-1800* (Manchester University Press, 2013) and I am currently developing a book that considers Lady Ranelagh within a wider social and intellectual context for how women practiced chemical medicine and science across the seventeenth century. I also work as CHF's Director of Digital Library Initiatives, where I write policies, establish workflows, and oversee the CHF team responsible for all aspects of digital collection development, including photography, metadata creation, digital preservation, and open-source software development. I previously worked as the Director of Digital Library Initiatives at the College of Physicians of Philadelphia and served on the Governance Group for the Medical Heritage Library consortium. Prior to my current position, I began my relationship with CHF in January 2014 when I was the recipient of an Allington Research Fellowship. I am pleased to bring my dual expertise in the history of early modern science and in humanities-based digital initiatives to my role as an advisor for this project.

If this grant is successful, I look forward to working with other historians and digital humanists as an advisor for CHF's *Age of Alchemy* game. This is an exciting time for new scholarship in the history of alchemy and early chemistry, and CHF's new game promises to make these research developments accessible to the public for the first time.

Sincerely,

Michelle DiMeo, Ph.D.

Bruce T Moran
Professor of History
University of Nevada, Reno

Fellowships, Appointments, and Awards
•Gordon Cain Distinguished Fellow, Chemical Heritage Foundation, 2014-15.
•Distinguished Visiting Faculty, Harvard University, Department of the History of Science, 2012-2013
•Dibner Distinguished Fellow in the History of Science and Technology, Huntington Library(2010-2011)
•University Outstanding Researcher Award (2009)
•Dean's Award for Research (2007)
•Research Fellow: Wellcome Trust Center for the History of Medicine at UCL, London (2004-2005)
•Adjunct Professor of Philosophy (2000-present)
•National Science Foundation Research Award (1997-1999)
•Visiting Fellow: Clare Hall and Dept. of the History and Philosophy of Science, Cambridge University (1997-1998)
•University of Nevada Foundation Professor (1993-present)
•Guest Professor: *Institut für Pharmaziegeschichte*, Marburg (1990-1991)
•Arts and Science Teaching Excellence Award (1988)
•Stipendiat, Alexander von Humboldt *Stiftung* (1983-1984; renewed 1985, 1987)
•Research Associate: Murhardsche Bibliothek und Landesbibliothek, Kassel (1983-1984)

Publications
Books: In Progress
Things Made and Things in the Making: Sentiment, Aspiration, and Practice in Early Modern Alchemy
Books: Under Contract and Forthcoming
 •*Paracelsus: Alchemy and the Liberation of Medicine* (London: Reaktion Books, due 2017)
•*A Cultural History of Chemistry* (6 vols.), vol. 3, *Renaissance and early Modern Chymistry* (London: Bloomsbury, due 2017/18).

Books: in Print
• *Bridging Traditions: Alchemy, Chemistry, and Paracelsian Practices in the Early Modern Era --Essays in Honor of Allen G. Debus*, co-ed. (Kirksville: Truman State University Press, 2015).
•*Andreas Libavius and the Transformation of Alchemy: Separating Chemical Cultures with Polemical Fire* (Sagamore Beach: Science History Publications, 2007).
•*Distilling Knowledge: Alchemy, Chemistry, and the Scientific Revolution* (Cambridge Mass.: Harvard University Press, 2005).
•*Disease and Medical Care in the Mountain West: Essays on Region, History, and Practice*, co-ed. (Reno/Las Vegas: University of Nevada Press, 1998).
•*The Alchemical World of the German Court: Occult Philosophy and Chemical Medicine at the Court of Moritz of Hessen* (Stuttgart: Franz Steiner Verlag, 1991).
•*Chemical Pharmacy at the University: Johannes Hartmann and the Didactic Care of Chymiatria* (Madison: American Institute of the History of Pharmacy, 1991).
•*Patronage and Institutions: Science, Technology, and Medicine at the European Court 1500-1750*, ed. (Woodbridge and Rochester: The Boydell Press, 1991).

Articles: Forthcoming
•"Preserving the Cutting Edge: Traveling Woodblocks, Material Networks, and Visualizing Plants in Early Modern Europe," in *Structures of Practical Knowledge*, ed. Matteio Valeriani (Max Planck Institute of the History of Science, Springer Verlag, forthcoming 2017).
•"The Subtleties of Enterprise: medical performance and the alchemy of plants in the ventures of Leonhard Thurneisser," in Jennifer Rampling and Peter Jones, eds., *Alchemy and Medicine from Antiquity to the Enlightenment* (forthcoming in *Science in Context*, 2017/18).

Articles and Chapters : in print, selected

•"The Court," in *A Companion to the History of Science*, ed. Bernard V Lightman (Chichester: John Wiley and Sons Blackwell, 2016), 210-223.

•"Paracelsus and Paracelsianism" in Glenn Magee, ed., *The Cambridge Handbook of Western Mysticism and Esotericism*. Cambridge: Cambridge University Press (Cambridge University Press, 2016), 156-170.

•"Introduction," pp. xiii-xxi, and "Andreas Libavius and the Art of *Chymia*: Words, Works, Precepts, and Social Practices," pp. 59-78 in Moran, ed., *Bridging Traditions: Alchemy, Chemistry, and Paracelsian Practices in the Early Modern Era* (Kirksville, 2015).

•"Eloquence in the Marketplace: Erudition and Pragmatic Humanism in the Restoration of Chymia," in *Chemical Knowledge in the Early Modern World*, ed. M. Eddy, S. Mauskopf, and W.R. Newman, *Osiris* 29 (2014), 49-62.

•"Art and Artisanship in Early Modern Alchemy," *The Getty Research Journal* 5 (2013), 1-14

•Editor, *Focus: Alchemy and the History of Science*, *Isis* 102 (June, 2011), 300-337, Introduction with contributions by Larry Principe (Johns Hopkins University), William Newman (Indiana University), Tara Nummedal (Brown University), and Kevin Chang (Academica Sinica, Taiwan).

•"The Singularity of Alchemical Experience: The Case of Camillo Baldi," in *Chymia: Science and Nature in Medieval and Early Modern Europe*, ed. Miguel López-Pérez, Didier Kahn and Mar Rey-Bueno (CSP: Newcastle upon Tyne, 2010), pp. 232-246.

•"Extracting the Virtues of Nature: Spagyric Remedies and Chemical Metaphors in the Library of Don Vincensio Juan de Lastanosa," in *The Gentleman, Virtuoso, and Inquirer: Vincenio Juan de Lastanosa and the Art of Collecting in Early Modern Spain*, ed. Mar Rey Bueno and Miguel López Pérez (CSP: Newcastle upon Tyne, 2008), pp. 144-156. Trans. "Extraer las Virtudes y los Secretos de la Naturaleza: Medicinas Químicas y Remedios Espagíricos en el Universo de Vincencio Juan de Lastanosa," in *El Inquiridor de Maravillas: prodigios, curiosidades y secretos de la naturaleza en la España de Vincencio Juan de Lastanosa,* ed. Mar Rey Bueno and Miguel López-Pérez (Huesca: Instituto de Estudios Altoaragoneses, 2011), pp. 337-350.

•"The Less Well-Known Libavius: Spirits, Powers, and Metaphors in the Practice of Knowing Nature," in Principe ed., *Chymists and Chymistry: Studies in the History of Alchemy and Early Modern Chemistry* (Sagamore Beach: Science History Publications, 2007), pp. 13-24.

•"The Book No One Will Write"(Author's Response), pp. 482-489, in Review Symposium, "Turning up the Mould In Search of the Gold," *Metascience* 15 (2006), 471-489.

•"Courts and Academies," in *The Cambridge History of Science*, ed. Park and Daston (Cambridge: Cambridge University Pres, 2006), vol. 3, pp. 251-271.

•"Axioms, Essences, and Mostly Clean Hands: Preparing to Teach Chemistry with Libavius and Aristotle," *Science and Education*, 15 (2006), pp. 173-187.

•"Knowing How and Knowing That: Artisans, Bodies, and Natural Knowledge in the Scientific Revolution" (essay review), *Studies in the History and Philosophy of Science* 36 (2005), pp. 577-585.

•"Paracelsianism," in *Dictionary of Gnosis and Western Esotericism*, ed. Wouter Hanegraff et al., Leiden: Brill, 2005, vol. 2, pp. 915-922.

•"Alchemy," "Paracelsus," "Jean Baptiste van Helmont" in *Europe 1450-1789: Encyclopedia of the Early Modern World* (New York: Charles Scribner's Sons, 2004), pp. vol. 1, 32-35; vol. 3, 146-147; vol. 4, 392-394.

•"Alchemy, Chemistry, and the History of Science" (essay review), *Studies in the History and Philosophy of Science* 31(2000), pp. 711-720.

•"Scientific Patronage," in Applebaum et al., *The Scientific Revolution: An Encyclopedia* (New York: Garland, 2000), 484-488.

•"Patronage Styles and Moritz the Learned as Alchemical Maesenas, in *Landgraf Moritz der Gelehrte: ein Kalvinist zwischwen Politik und Wissenschaft*," ed. Gerhard Menk (Trautvetter und Fischer: Marburg, 2000), pp. 215-228.

•"Medicine, Alchemy, and the Control of Language: Andreas Libavius vs. the Neoparacelsians," in *Paracelsus: The Man and His Reputation, His Ideas and the Transformation*, ed. Ole Peter Grell (Leiden: Brill, 1998), 135-149.

•"Libavius the Paracelsian? Monstrous Novelties, Institutions, and the Norms of Social Virtue," in Allen Debus and Michael Walton eds., *Reading the Book of Nature: The Other Side of the Scientific Revolution* (Kirksville: Sixteenth Century Journal Publishers, 1998), 67-79.

•"Paracelsus, Religion, and Dissent: The Case of Philipp Homagius and Georg Zimmermann," *Ambix*, 43 (1996), pp. 65-79.

Dr. Bruce Moran
Professor of History
University of Nevada, Reno
Lincoln Hall, 202
Reno, NV 89512

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

May 18, 2017

Dear Dr. McLeary,

I am pleased to commit to an advisory relationship with The Chemical Heritage Foundation (CHF) for their *Age of Alchemy* Game Project and in support of their application for a Digital Projects for the Public Prototyping grant from the National Endowment for the Humanities (NEH). This project will be a valuable contribution to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern alchemy and science for a broader public.

I greatly enjoyed my experiences at CHF, as the 2014-2015 Gorden Cain Distinguished Fellow, and the opportunity to conduct research in your extensive alchemical collections. My forthcoming book, *Alchemical Practices and the Objects of Everyday*, will explore some of the same fertile ground that is expressed visually in CHF's collections—the ephemera, tools, objects, and mundane practices that circulated within and around alchemical inquiry.

As the author of *The Alchemical World of the German Court* (1991); *Chemical Pharmacy Enters the University: Joahnnes Hartmann and the Didactic Care of Chymiatria* (1991); *Distilling Knowledge: Alchemy, Chemistry, and the Scientific Revolution* (2005); and *Andreas Libavius and the Transformation of Alchemy: Separating Chemical Cultures with Polemical Fire* (2007), I am eager to be a part of a project which I believe has the capacity to translate and share alchemy's rich culture and history with new audiences.

In closing, please accept this letter as proof of my commitment to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to working with your game design and research teams, should your NEH application be accepted.

Sincerely,

Bruce Moran, PhD

Biographical Sketch of William R. Newman

Undergraduate Institution

University of North Carolina at Greensboro, History of Science and Proto-Science, B.A., 1978.

Graduate Institution

Harvard University, History of Science, Ph.D., 1986.

Appointments

Indiana University, History and Philosophy of Science, 1996 – present, Distinguished Professor, Ruth N. Halls Professor.

Harvard University, History of Science, Associate Professor, 1993-1996, Assistant Professor, 1989-1993.

Stonehill College, History of Science, 1986-1989, Assistant Professor.

Relevant Publications

Chemical Knowledge in the Early Modern World (co-edited with Seymour Mauskopf and Matthew Eddy), *Osiris* 29(2014).

"Newton's Early Optical Theory and its Debt to Chymistry," in Danielle Jacquart and Michel Hochmann, eds., *Lumière et vision dans les sciences et dans les arts* (Geneva: Droz, 2010), pp. 283-307.

"Newton's Theory of Metallic Generation in the Previously Neglected Text 'Humores minerales continuo decidunt'," in Lawrence M. Principe, ed., *Chymists and Chymistry: Studies in the History of Alchemy and Early Modern Chemistry* (Sagamore Beach, MA: Chemical Heritage Foundation and Science History Publications, 2007), pp. 89-100.

"The Background to Newton's Chymistry," in *The Cambridge Companion to Newton*, I. Bernard Cohen and George Smith, eds. (Cambridge: Cambridge University Press, 2002), pp. 358-369.

Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry (with Lawrence M. Principe), (Chicago: University of Chicago Press, 2002).

Other Selected Publications

"What Have we Learned from the Recent Historiography of Alchemy?" Focus Section, *Isis* 102(2011), pp. 31 3-321.

George Starkey: Alchemical Laboratory Notes and Correspondence (with Lawrence M. Principe) (Chicago: University of Chicago Press, 2004)

"Some Problems with the Historiography of Alchemy" (with Lawrence M. Principe), in *Secrets of Nature: Astrology and Alchemy in Early Modern Europe* (volume of articles co-edited with Anthony Grafton)*,* (Cambridge, MA: MIT Press, 2001), pp. 385-431.

"Alchemy vs. Chemistry: The Etymological Origins of a Historiographic Mistake" (with Lawrence M. Principe), in *Early Science and Medicine* 3(1998), pp. 32-65.

Synergistic Activities

2010 Gave public lecture with laboratory-based demonstrations of "Why Newton Believed in Alchemy" for Perimeter Institute for Theoretical Physics, Waterloo, Ontario.

2005 – Developed a sequence of replicated chymical experiments based on Isaac Newton's laboratory notebooks for use in NOVA documentary, "Newton's Dark Secrets."

2002 – Built a working replica of Newton's chymical-metallurgical wind-furnace described in the University of Chicago Schaffner MS. for BBC documentary, "Newton – The Dark Heretic."

1996 – Wrote successful grant proposal for $100,000 in funding from the Strategic Directions Initiative at Indiana University to create a new interdisciplinary area certificate program centered on the Department of History and Philosophy of Science.

1995 – Conceived and developed annual teacher-training program for Department of History of Science at Harvard University. The program is still in effect. Conceived and developed simultaneously an undergraduate conference series for Harvard History of Science Department, the first to be held at Harvard University.

William R. Newman, PhD
Distinguished Professor, Ruth N. Halls Professor
Department of History and Philosophy of Science
Indiana University
1020 Kirkwood Ave., Ballantine Hall 644
Bloomington, IN 47405

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

24 May 2017

Dear Dr. McLeary,

I am pleased to submit this letter of support for The Chemical Heritage Foundation's application for funding from the National Endowment for the Humanities' (NEH) Digital Projects for the Public program for CHF's *Age of Alchemy* game. This letter also represents my commitment to serve as a humanities advisor for the *Age of Alchemy* Game Project. This project will be a valuable contribution to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

I began my relationship with CHF in (2015) when I served as Gordon Cain Distinguished Fellow. My role at CHF included research on Isaac Newton's alchemy for the purpose of writing a book on the subject. During that time I also co-organized an NEH sponsored workshop on a proposed Chymical Encyclopedia, Database, and Repository (with James Voelkel of the CHF). The workshop took place in May 2016.

I should add that my entire scholarly career has focused on the history of alchemy. My doctoral dissertation, later published in 1991 as *The Summa perfectionis of pseudo-Geber*, was a study of the most influential alchemical text of the Middle Ages. My subsequent work has focused on early modern "chymistry" as well as medieval alchemy. In closing, please accept this letter as proof of my intent to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to fulfilling my capacity as an advisor, should your NEH application be accepted.

Sincerely,

William R. Newman, PhD

Curriculum Vitae (2017)
Lawrence M. Principe

<u>Office Address</u>: Department of the History of Science and Technology, 301 Gilman Hall, Johns Hopkins University, Baltimore, MD 21218 USA *or* Chemistry Department, Remsen Hall, Johns Hopkins University, Baltimore, MD 21218 USA.

<u>Education:</u>
1996 Ph.D.; History of Science, Johns Hopkins University.
1988 Ph.D.; Organic Chemistry, Indiana University.
1983 B.S.; Chemistry, University of Delaware.
1983 Honors B.A.; Liberal Studies, University of Delaware.

<u>Positions Held:</u>
2011- Director, Singleton Center for the Study of Premodern Europe, JHU
2006- Drew Professor of the Humanities, Department of the History of Science and
 Technology and Department of Chemistry, Johns Hopkins University.
2010 F. C. Donders Professor, Universiteit te Utrecht
2002-06 Professor, HST and Chemistry, JHU
2005 Francis Bacon Visiting Professor of History, California Institute of Technology
1999-02 Associate Professor, HST and Chemistry, JHU
1997-99 Assistant Professor, HST and Chemistry, JHU
1996-97 Associate Research Scientist, Chemistry Department, JHU
1994-97 Senior Lecturer of Chemistry, Chemistry Department, JHU
1989-94 Lecturer of Chemistry and Laboratory Instructor, Chemistry Department, JHU.

<u>Selected Publications:</u>
 Books:
The Secrets of Alchemy (Chicago: University of Chicago Press, 2013).
The Scientific Revolution: A Very Short Introduction (Oxford: Oxford University Press, 2011).
 [Spanish ed. (Madrid: Alianza, 2013); Swedish ed. (Stockholm: Fri Tanke, 2013); Chinese ed. (Yilin Press, 2013); Arabic ed.(Cairo: Hindawi Publishing, 2014); Japanese ed. (Tokyo: Maruzen, 2014); Korean (forthcoming).]
Chymists and Chymistry: Studies in the History of Alchemy and Early Modern Chemistry, ed. (Sagamore Beach, MA: Science History Publications, 2007).
The Alchemical Laboratory Notebooks and Correspondence of George Starkey. With William R. Newman. (Chicago: University of Chicago Press, 2004).
Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry. With William R. Newman. (Chicago: University of Chicago Press, 2002).
Transmutations: Alchemy in Art. With Lloyd DeWitt. (Philadelphia: Chemical Heritage Foundation, 2002).
The Aspiring Adept: Robert Boyle and His Alchemical Quest. (Princeton: Princeton University Press, 1998).
 Media/Public Education:
Science and Religion, (a video course in twelve 30-minute lectures; produced by The Teaching Company, Chantilly, VA 2006).
History of Science: Antiquity to 1700, (a video course in thirty-six 30-minute lectures; produced by The Teaching Company, Chantilly, VA, 2003).
 Articles:
"The Chymist and the Physician: Rivalry and Conflict at the *Académie Royale des Sciences*," in *Medicine and Alchemy*, ed. Jennifer Rampling (Cambridge: Cambridge University Press, forthcoming 2017).
"Bühnen der Alchemie: Theaterdrama innerhalb und außerhalb des Laboratoriums," pp. 228-249 in *Spuren der Avantgarde: Theatrum alchemicum, frühe Neuzeit und Moderne im Kulturvergleich*, eds. Helmar Schramm, Michael Lorber, and Jan Lazardzig (Berlin: De Gruyter, 2017).
"Chymical Exotica in the Seventeenth Century, or, How to Make the Bologna Stone," *Ambix* 63 (2016):118-44.

"From the Library to the Laboratory and Back Again: Experiment as a Tool for Historians of Science," (with Hjalmar Fors and H. Otto Sibum), *Ambix* 63 (2016):85-97 [Guest edited issue]

"Goldsmiths and Chymists: The Activity of Artisans in Alchemical Circles," pp. 157-179 in *Laboratories of Art: Alchemy and Art Technology from Antiquity to the Eighteenth Century*, ed. Sven Dupré, (Dordrecht: Springer, 2014).

"Revealing Analogies: The Descriptive and Deceptive Roles of Sexuality and Gender in Latin Alchemy," pp. 209-229 in *Hidden Intercourse: Eros and Sexuality in Western Esotericism*, eds. Wouter Hanegraaff and Jeffrey J. Kripal, (Leiden: Brill, 2008).

"Alchemy and Its Images in the Eddleman and Fisher Collections at the Chemical Heritage Foundation." With Lloyd DeWitt. Pp. 221-47, in *Art and Alchemy*, ed. Jacob Wamberg (Copenhagen: Museum Tusculum, 2005).

"Reflections on Newton's Alchemy in Light of the New Historiography of Alchemy." Pp. 205-19 in *Newton and Newtonianism: New Studies*, eds. James E. Force and Sarah Hutton, (Dordrecht: Kluwer, 2004).

"Some Problems in the Historiography of Alchemy." With William R. Newman. Pp. 385-434 in: *Secrets of Nature: Astrology and Alchemy in Early Modern Europe*, ed. William Newman and Anthony Grafton, (Cambridge, MA: MIT Press, 2001).

Recent Presented Papers:

"Locality, Materials, and Reproductions," Journée d'étude: *L'Atelier de la Nature*, Centre Alexandre Koyré, Paris, France, 10 November 2016.

"Rêves d'or: La surprenante longévité de l'alchimie au coeur de la chimie," La Maison de la Chimie, Paris, France, 9 November 2016. [Address upon reception of the Prix Franklin-Lavoisier.]

"The Fates and Futures of Alchemy and Medieval Natural Philosophy," Plenary Lecture for the "Science Before Science" Symposium, Bowdoin College, ME, 26 February 2015.

"Alchemy on the Cutting Edge: Theoretical Innovations and the Pursuit of Transmutation," Dibner Distinguished Lecture, Smithsonian Institution, Washington, DC, 11 December 2014.

Selected Honors, Awards, and Fellowships:

2016, Prix Franklin-Lavoisier, Foundation de la Maison de la Chimie and Chemical Heritage Foundation

2016, Rausing Fellowship, Uppsala University, Sweden

2015-16, John Simon Guggenheim Memorial Fellowship

2015, Elected *Membre Effectif* (Fellow) of the Académie internationale d'histoire des sciences

2014, Dibner Lecturer, Smithsonian Institution

2011, George Sarton Memorial Lecturer, American Academy of Arts and Sciences

Recent Grants:

"Sources of Alchemy," Society for the History of Alchemy and Chemistry, £800, 2015

"The Supernova of 1604 as a Source of Scientific Debate," National Science Foundation, 2008-2010, $84,000.

"International Conference on Early Chemistry," National Science Foundation, 2005-2006; $10,000.

"The Formation of Chemists and Chemistry," National Science Foundation CAREER Grant, 2000-2006; $273,348.

Conferences and Workshops Organized:

"Greek, Coptic, Syriac and Arabic Alchemy," Assisi, Italy 22-26 August 2015.

"Early Sources of Alchemy," 7-10 May 2014, Johns Hopkins University, Baltimore.

"L'Accademia del Cimento nel Contesto Europeo," 14-15 December 2007, Istituto e Museo di Storia dell Scienza, Florence, Italy.

International Conference on Alchemy and Chymistry, 19-22 July 2006, Chemical Heritage Foundation, Philadelphia, PA; ca. 120 participants.

Francis Bacon Workshop on 18th Century Chemistry, 21-23 April 2005, CalTech, Pasadena, CA.

**The Charles Singleton Center for the
Study of Premodern Europe**

3400 North Charles Street
Baltimore MD 21218
410-516-5296 / Fax 410-516-7586
Lmafp@jhu.edu
http://krieger.jhu.edu/singleton

Lawrence Principe
~~Interim~~ Director

5 June 2017

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, Pa., 19106

Dear Dr. McLeary,

I am pleased to commit to an advisory relationship with The Chemical Heritage Foundation (CHF) for their *Age of Alchemy* Game Project and in support of their application for a Digital Projects for the Public Prototyping grant from the National Endowment for the Humanities (NEH). This project will be a valuable contribution to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

My expertise lies in the history of alchemy, and I have published and spoken widely on the topic over the past thirty years. I began my relationship with CHF over twenty years ago, serving in multiple roles both as a fellow and as a consultant. My role at CHF included cataloguing, studying, and publicizing the large collection of alchemical art acquired by CHF, which resulted in the publication of *Transmutations: Alchemy in Art* (2002). I was later brought in to help organize, study, and publicize the Neville Collection of rare books and manuscripts, which resulted not only in several publications, but in my organizing an international conference on alchemy in 2006. Since that time I have worked regularly with CHF staff on numerous projects that include giving public lectures, setting up fellowships, acquiring alchemical books and manuscripts, organizing exhibition displays, and participating in events both public and private.

In closing, please accept this letter as proof of my intent to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to fulfilling my capacity as an advisor, should the NEH application be accepted.

Sincerely yours,

Lawrence M. Principe, Ph.D.
Drew Professor of the Humanities
Department of the History of Science and Technology
    and Department of Chemistry
Director, Singleton Center for the Study of Premodern Europe

David T. Schaller

Eduweb
1776 Iglehart Avenue
St. Paul, MN 55104

Phone: (651) 641-7566
Fax: (651) 917-9481
david@eduweb.com

EDUCATION

Macalester College, St. Paul, MN
 B.A. in Humanities, 1986.

University of Minnesota, Geography Department, Minneapolis, MN.
 M.A. in Geography and Museum Studies, 1996.
 Emphasis on ecotourism as educational and development tool

PROFESSIONAL EXPERIENCE

Principal (1997 - present)
 Eduweb, St. Paul, Minnesota

Responsible for creative and business development of firm. Lead developer of digital learning games and interactives for informal educational organizations, also leads research on applications of interactive media and learning theory.

Industry Awards:
- Gold, Silver, Bronze and Honorable Mention MUSE Awards, American Association of Museums 2002-2012
- Best of the Web, Educational Use, Museums and the Web 2000, 2001, 2004, 2008
- Award of Merit, American Association for State and Local History, 2006, 2010, 2011, 2012
- Pirelli *INTERNET*ional Award, Top Prize and Physics Category Winner, 2005

Selected Projects:

 Project Manager and Game Designer, *Traders & Raiders,* Historic Hudson Valley, Tarrytown, NY. 2015-2017.

 Project Manager and Game Designer, *Cold War Dare,* George Bush Presidential Library and Museum, College Station, TX. 2015-2016.

 Project Manager and Game Designer, *Wright Brothers' Workshop,* National Air and Space Museum, Smithsonian Institute, Washington, D.C. 2014-2016.

Co-Principal Investigator for learning game funded by the National Science Foundation, *WolfQuest: Learning through gameplay,* 2007-present.

Principal Investigator for research study funded by the National Science Foundation, *A Study of The Relationship between Learning Style and Preference for Online Informal Educational Activities.* Grant #ESI-0337116. 2005-2007.

 Game Producer, *Betwixt Folly and Fate,* Colonial Williamsburg Foundation. 2008. Gold MUSE Award Winner, American Association of Museums.

Freelance Exhibit Writer (1994 – 1998)
   Wrote exhibit text for natural science and history museums and informal learning centers around the country, including the Bell Museum of Natural History, Great Lakes Aquarium, Sioux Falls Outdoor Campus, Kentucky History Center, and Jefferson Davis Presidential Library.

PUBLICATIONS

D. Schaller. (2014.) Game Mechanics and the Museum: Designing simple gameplay around complex content. In N. Proctor & R. Cherry (eds), *Museums and the Web 2014*. Silver Spring, MD: Museums and the Web.

Schaller, D. (2011.) The Meaning Makes It Fun: Game-Based Learning for Museums. *Journal of Museum Education.* 36(3). 261-268.

Schaller, D. (2011). "From Knowledge to Narrative – to Systems? Games, Rules and Meaning-making." In J. Trant and D. Bearman (eds). *Museums and the Web 2011: Proceedings.* Toronto: Archives & Museum Informatics.

Schaller, D.T., Haley Goldman, K., Spickelmier, G., Allison-Bunnell, S.W., Koepfler, J. (2009). Learning in the Wild: What WolfQuest taught developers and players. In D. Bearman and J. Trant's (Eds.) *Museums and the Web 2009: Proceedings.* Toronto: Archives & Museum Informatics.

Schaller, D.T. 2007. "Playing Games with History." History News. 62(3), 5-6.

Edwards, S.E. and Schaller, D.T. (2007). The Name of the Game. In H. Din and P. Hecht (eds). *The Digital Museum: A Think Guide.* Washington, D.C.: American Association of Museums.

Schaller, D.T., Borun, M., Allison-Bunnell, S.W. and Chambers, M. (2007). One Size Does Not Fit All: Learning Style, Play, and On-line Interactives. In J. Trant and D. Bearman (eds). *Museums and the Web 2007: Selected Papers from an International Conference.* Toronto: Archives and Museum Informatics.

Haley Goldman, K. and Schaller, D.T. (2004). Exploring Motivational Factors and Visitor Satisfaction in On-line Museum Visits. In D. Bearman & J. Trant, (eds.), *Museums & the Web 2004: Selected Papers from an International Conference.* Toronto: Archives and Museum Informatics.

Schaller, D.T., and Allison-Bunnell, S.W. (2003). Practicing What We Teach: How learning theory can guide development of online learning activities. In D. Bearman & J. Trant, (eds.), *Museums & the Web 2003: Selected Papers from an International Conference.* Pittsburgh: Archives and Museum Informatics.

PROFESSIONAL ACTIVITIES

Workshop Instructor, American Association of State and Local History annual conference, 2014-2015.

Advisor, Play the Past, Minnesota Historical Society, 2012-13.

Workshop Instructor, Museums and the Web annual conference, 2001-2014

Media and Technology Committee Board, American Association of Museums, 2002- 2008

Panel reviewer, National Science Foundation Informal Science Education, 2004, 2005.

Advisor, Exhibit and Multimedia Planning, Weeksville Heritage Society, 2006, 2007, 2011

May 3, 2017

Charles McGhee Hassrick
Digital Projects Manager
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

Dear Charles,

It has been a pleasure to talk with you about the Chemical Heritage Society's game, *Age of Alchemy*, and I enthusiastically agree to serve on the advisory committee for this project. I see great potential for creating playful and meaningful gameplay about seventeenth-century alchemy. We have produced many such history games over the years (such as "A Sailor's Life for Me," developed with the USS Constitution Museum, which drops players into the exciting world of Old Ironsides — and which won awards from AAM and AASLH). With such rich prospects for exciting and meaningful experiences, I'm excited about participating in the advisory board meetings with you and the project team.

My firm, Eduweb, develops award-winning digital learning games and apps for museums and other educational organizations. Our mission is to create exciting and effective learning experiences that hit the sweet spot where learning theory, digital technology, and fun meet. Over the past twenty years, we've developed over 200 digital learning games and apps, including many that explore American history and cultural heritage for Colonial Williamsburg, the National Park Service, and other historic sites and history museums around the country.

I'm pleased to offer my commitment to the project's advisory committee meetings and appreciate the honorarium. I look forward to helping in any way I can.

Sincerely,

David Schaller
Principal

Curriculum Vitae
PAMELA H. SMITH
http://www.history.columbia.edu/faculty/Smith.html

Office Address
Department of History, Columbia University, 605 Fayerweather Hall, MC 2516, 1180 Amsterdam Avenue, New York, N.Y. 10027, Phone: (212) 854-7662, email: ps2270@columbia.edu

EDUCATION
THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland (1983-1990)
Ph.D., May 1991. Department of the History of Science.
Dissertation: "Alchemy, Credit, and the Commerce of Words and Things: Johann Joachim Becher at the Courts of the Holy Roman Empire, 1635-82" (Adviser: Owen Hannaway).
UNIVERSITY OF WOLLONGONG, Wollongong, New South Wales, Australia (1976-79)
B.A. First Class Honors, November 1979. Major: History and Philosophy of Science.

EMPLOYMENT
2005-present: Seth Low Professor of History, Columbia University, New York. Courses in early modern European history and history of science.
2014-present: Chair, Presidential Scholars in Society and Neuroscience
The aim of this crosscutting initiative is to bring together scholars from all fields around questions of brain and mind. A community of postdoctoral scholars will form the heart of a rich program of interdisciplinary events and research. http://presidentialscholars.columbia.edu/
2013- present: Founding Director, Center for Science and Society, Columbia University
http://scienceandsociety.columbia.edu/
2000-2005: Margaret and Edwin F. Hahn Professor in the Social Sciences, and Professor of History, Pomona College (1990-2005: Assistant and Associate Professor of History)
1996-2003: Director of European Studies, Claremont Graduate University
1992-2003 (excluding leaves): Chair, Science, Technology and Society Program of the Claremont Colleges

RECENT FELLOWSHIPS AND GRANTS
Gerda Henkel Foundation: Making and Knowing Postdoctoral Research Scholar, February 2017-January 2019.
NSF: Summer Workshop Grant #1656227 for Making and Knowing Paleography/Translation Workshop, June 19-30, 2017.
NEH: Scholarly Editions and Translations Grant #RQ249842 for "Craft Techniques and Knowledge Systems in a 16th-Century Artist's Manuscript: An Open-Access Critical Edition and Translation," October 2016-September 2019.
Collaboratory@Columbia: Seed Grant, September 2016-August 2018.
Andrew Mellon Foundation: Grant awarded to Columbia University for the founding of the Center for Science and Society at Columbia University, October 1-September 30, 2017.
NSF: Research Grant #1430843 "The Role of Tacit Knowledge in Experimentation," September 1, 2014-August 30, 2017.
http://www.mpiwg-berlin.mpg.de/en/research/projects/DeptII_Smith_Itineraries

SELECTED HONORS AND AWARDS
2016: Distinguished Lecturer, Center for Renaissance and Reformation Studies, University of Toronto
2014: Dean's Distinguished Lecturer in the Humanities, Columbia University Medical School
2013: Provost's University Lecture, Columbia University
2009-10: Fellow, Davis Center for Historical Studies, Princeton University

SELECTED PUBLICATIONS: BOOKS
The Matter of Art: Materials, Practices, Cultural Logics, c. 1250-1750, co-edited with Christy Anderson and Anne Dunlop, Manchester University Press, 2015. Paperback January 2016.
Ways of Making and Knowing: The Material Culture of Empirical Knowledge, co-edited with Amy R. W. Meyers and Harold J. Cook, Bard Graduate Center/University of Michigan Press, 2014.
Making Knowledge in Early Modern Europe: Practices, Objects, and Texts, 1400-1800, co-edited with Benjamin Schmidt, Chicago: University of Chicago Press, 2008.

The Body of the Artisan: Art and Experience in the Scientific Revolution, Chicago: University of Chicago Press, 2004. Paperback edition, 2005. Winner of the 2005 Leo Gershoy Prize for early modern European History awarded by the American Historical Association.

Merchants and Marvels: Commerce, Science and Art in Early Modern Europe, co-edited with Paula Findlen, New York: Routledge, 2002.

Books in preparation:

Edited volume: *Entangled Itineraries of Materials, Practices, and Knowing: Eurasian Nodes of convergence and transformation (from bronze to tea)*, in preparation.

From Lived Experience to the Written Word: Recovering Art and Skill in Early Modern Europe, in preparation.

Digital Editions:

Craft and Science: From the Workshop to the Laboratory. An Open-Access Digital Critical Edition and Translation of a Sixteenth-Century French Practitioner's Manuscript, BnF Ms. Fr. 640 (in preparation). www.makingandknowing.org

SELECTED PUBLICATIONS: ARTICLES

"Making and Knowing," *VARIorum: The Journal of the V&A Research Institute*, forthcoming 2017.

"Materials, Mimesis, and Meaning in Linda Bond's *Prayer*," in *Salvage Art*, ed. Elka Krajewska, forthcoming.

"The Making and Knowing Project," Exhibition Catalog, *L'Accademia all'académie: il disegno dal vero come pratica storica e sapere contemporaneo* (Rome, 2017).

"The Codification of Vernacular Theories of Metallic Generation in sixteenth-century European Mining and Metalworking," *The Structures of Practical Knowledge: Toward Early Modern Science*, Matteo Valeriani, ed. (Springer/Dordrecht, 2017): 371-392.

"Historians in the Laboratory: Reconstruction of Renaissance Art and Technology in the Making and Knowing Project," *Art History*, special issue on Art and Technology, 39.2 (2016): 210-233.

"Itineraries of Materials and Knowledge in the Early Modern World," *The Global Lives of Things*, Anne Gerritsen and Giorgio Riello, eds. (Routledge, 2015), pp. 31-61.

"What is a Secret? Secrets and Craft Knowledge in Early Modern Europe," *Secrets and Knowledge in Medicine and Science, 1500-1800*, ed. by Elaine Leong and Alisha Rankin (Ashgate, 2011): 47-66.

SELECTED PUBLIC OUTREACH

Kean, Sam. "Twenty-First-Century Alchemists," *The New Yorker*. 26 Sept. 2016.

The Recipes Project, "A Recipe for Recipe Research: The Making and Knowing Project," February 2016. See also "Making 'Powder for Hourglasses' in the Early Modern Household."

WHYY visits Smith's Making and Knowing Project in The power of failure, and other lessons from a 400-year-old 'book of secrets'

RECENT INVITED LECTURES

2016: "Historians in the Laboratory: The Making and Knowing Project," Cal Tech, 9 Nov.

 "Making Art and Knowing Nature," UC Berkeley, 7-8 April.

Distinguished Lectureship, Center for Renaissance and Reformation Studies, University of Toronto, 14-16 March (2 lectures and 2 graduate workshops).

2015: "Philosophizing Artworks in Early Modern Europe," Art and Science, Rijksmuseum, Amsterdam, 17 September.

2014: "Science, Art, and Medicine: A Historian in the Laboratory," Dean's Distinguished Lecturer in the Humanities, Columbia University Medical School, 13 October.

2013: "Snakes, Lizards, and Manuscripts: Humanists in the Laboratory," University Lecture, Columbia University, 2 December. Available here: http://www.youtube.com/watch?v=NhRXVKDlYjo&feature=youtu.be

SELECTED CONFERENCES ORGANIZED

"Colormaking in BnF Ms. Fr. 640," Working Group of the Making and Knowing Project, 26-28 May 2016.

"Historical Reconstruction in Early Modern Europe," co-organizer, Chemical Heritage Foundation, Philadelphia, 9-10 October 2015.

"Itineraries of Materials, Recipes, Techniques, and Knowledge in the Early Modern World," Max Planck Institute for the History of Science, Berlin, March & July 2014, July 2015.

International Conference on the History of Alchemy and Chymistry (Advisory Committee), 19–22 July 2006, Chemical Heritage Foundation, Philadelphia.

Dr. Pamela H. Smith
Seth Low Professor of History & Director of the Center for Science and Society
Columbia University
605 Fayerweather Hall, MC 2516
1180 Amsterdam Avenue
New York, N.Y. 10027

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

7 June 2017

Dear Dr. McLeary,
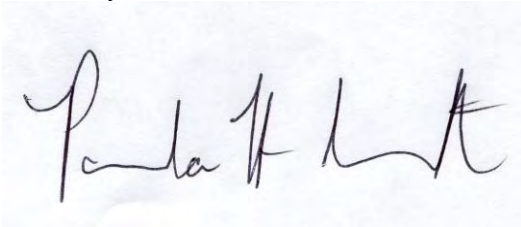
I am pleased to commit to an advisory relationship with The Chemical Heritage Foundation (CHF) for their *Age of Alchemy* Game Project and in support of their application for a Digital Projects for the Public Prototyping grant from the National Endowment for the Humanities (NEH). This project will be a valuable contribution to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

I hold a Ph.D. from Johns Hopkins University and I am the Seth Low Professor of History at Columbia University. I specialize in early modern European history and the history of science. My current research focuses on attitudes to nature in early modern Europe and the Scientific Revolution, with particular attention to craft knowledge and historical techniques. I am the founding director of the Center for Science and Society (http://scienceandsociety.columbia.edu/), chair of the Presidential Scholars in Society and Neuroscience (http://presidentialscholars.columbia.edu/), and the 2016-18 President of The Renaissance Society of America.

I am also the founding director of the interdisciplinary research group the Making and Knowing Project (http://www.makingandknowing.org/), which was recently awarded an NEH Scholarly Editions and Translations Grant. The Making and Knowing Project is exploring several different, interconnected digital experiences as we develop the full digital critical edition of the project's key manuscript, Ms. Fr. 640, for which the first beta release is scheduled for late 2019. I am excited to collaborate on CHF's *Age of Alchemy* Game Project and contribute from my experiences in the history of science as well as in developing innovative digital projects for the public.

In closing, please accept this letter as proof of my intent to serve as a humanities advisor for CHF's *Age of Alchemy* Game Project. I am looking forward to fulfilling my capacity as an advisor, should your NEH application be accepted.

Sincerely,

Pamela H. Smith, Ph.D.

James R. Voelkel

Chemical Heritage Foundation
315 Chestnut St.
Philadelphia, PA 19106

Tel. 215-873-8271
Fax.   215-629-5271
jvoelkel@chemheritage.org

Current Positions

DONALD F. AND MILDRED TOPP OTHMER LIBRARY OF CHEMICAL HISTORY
Curator of Rare Books, curating a world-class research collection of approximately 6,000 rare books and manuscripts in the history of science from the 15th to the 20th century; acquiring new books across a wide range of primarily chemical disciplines with an acquisition budget of approximately $200,000 per year; curating exhibits and engaging in public outreach through events, magazine articles and podcasts.

ARNOLD AND MABEL BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY
Resident Scholar, conducting independent research in the history of early modern science; acting as PI for an NEH sponsored foundation grant for a digital humanities project entitled "A Chymical Encyclopedia, Database, and Repository."

DEPARTMENT OF HISTORY AND SOCIOLOGY OF SCIENCE, UNIVERSITY OF PENNSYLVANIA
Lecturer, teaching STSC 202: The Scientific Revolution.

THE CHYMISTRY OF ISAAC NEWTON PROJECT
Senior Editorial and Encoding Consultant, as a senior member of the editorial staff, helping to maintain and establish best encoding practices and to edit the online edition of Newton's alchemical manuscripts; helping to supervise postdoctoral and graduate students working on linking Newton's notes to their printed sources.

Education

Ph.D. in history of science, Indiana University, Bloomington, Indiana, 1994.
M.A. in natural sciences (history and philosophy of science), Emmanuel College, Cambridge
        University, Cambridge, England, 1990. (Commuted from B.A. hons., 1986.)
M.A. in history and philosophy of science, Indiana University, Bloomington, Indiana, 1989.
B.A. with honors in astronomy and physics, Williams College, Williamstown, Massachusetts, 1984.

Professional Certification

Certificate of Proficiency in Bibliography, Rare Book School, Charlottesville, Virginia, Oct. 2012.

Previous Positions

THE CHYMISTRY OF ISAAC NEWTON PROJECT (chymistry.org)
7/05-12/07 & 3/04-9/04, *Senior Editor and Encoder*. Transcribed and encoded Newton's alchemical manuscripts in TEI xml. Completed numerous Newtonian alchemical manuscripts, including Newton's most complete alchemical notebook, Portsmouth Add. MS. 3975.

DIBNER INSTITUTE FOR THE HISTORY OF SCIENCE AND TECHNOLOGY
9/04-5/05, *Senior Fellow*, worked on translation with commentary of Kepler's *Rudolphine Tables*.

HISTORY OF RECENT SCIENCE AND TECHNOLOGY ON THE WEB
10/03-8/04, *System administrator and Curator* of HRST website.
6/01-9/03, *Digital Library Manager* (software developer), managing integration with Perseus digital library software with HRST digital library.

JOHNS HOPKINS UNIVERSITY, Dept. of History of Science, Medicine, and Technology
7/99-6/01, *Postdoctoral Teaching Fellow.*

DIBNER INSTITUTE FOR THE HISTORY OF SCIENCE AND TECHNOLOGY
9/97-8/99, *Postdoctoral Research Fellow*.

HARVARD UNIVERSITY
9/95-6/97, *Head Teaching Assistant* for Core Science A-17/B-17: The Astronomical Perspective, and *Teaching Assistant* in the Department of History of Science.

WILLIAMS COLLEGE, Dept. of Astronomy
7/94-6/95, *Visiting Assistant Professor of Astronomy and History of Science.*

Grants

"Foundation Proposal for a Chymical Encyclopedia, Database, and Repository (CEDR)," National Endowment for the Humanities, PW-228135-15, awarded 3/20/2015.

Exhibitions

Books of Secrets: Writing & Reading Alchemy, Clifford C. Hach Gallery, Chemical Heritage Foundation, December 5, 2014–September 4, 2015.
The Alchemical Quest, Clifford C. Hach Gallery, Chemical Heritage Foundation, July 2–December 7, 2012.

Books

The Composition of Kepler's Astronomia Nova (Princeton: Princeton University Press, 2001).
Johannes Kepler and the New Astronomy [Portraits in Science Series] (New York: Oxford University Press, 1999). Translated into Turkish (Ankara: Tübitak), Arabic (Riyadh: Obeikan), Chinese, and Japanese.

Selected Articles

"Giovanni Antonio Magini's 'Keplerian' Tables of 1614 and their Implications for the Reception of Keplerian Astronomy in the Seventeenth Century"(with Owen Gingerich), *Journal for the History of Astronomy*, 32 (2001): 237-262.
"Publish or Perish: Legal Contingencies and the Publication of Kepler's Astronomia nova," *Science in Context*, 12:1 (1999), 33-59.
"Tycho Brahe's Copernican Campaign" (with Owen Gingerich), *Journal for the History of Astronomy*, 29 (1998), 1-34.

Languages

German (fluent), Latin, and French.

Professional Associations

American Library Association; History of Science Society; Society for the History of Authorship, Reading, and Publishing; Society for the History of Alchemy and Chemistry; HIST section of the American Chemical Society.

2 June 2017

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

Dear Dr. McLeary,

I am pleased to submit this letter of support for The Chemical Heritage Foundation's application for funding from the National Endowment for the Humanities' (NEH) Digital Projects for the Public program for CHF's *Age of Alchemy* game. This letter also represents my commitment to serve as a humanities advisor for the project. *Age of Alchemy* will be a valuable contribution to CHF's continuing efforts to interpret and make accessible our artworks and manuscripts related to the history of early modern alchemy and science for broader public audiences.

As a scholar of early modern science, I have published on early modern scientific figures, such as Johannes Kepler and Tycho Brahe, for both academic and public audiences. I am also a senior consulting editor for the Chymistry of Isaac Newton web project [www.chymistry.org], a web-based critical electronic edition of the alchemical manuscripts of Isaac Newton. I am Curator of Rare Books at CHF's Othmer Library of Chemical History, where I am responsible for CHF's world-class holdings of rare books and manuscripts related to early modern alchemy and science. In addition, I am responsible for the acquisition of rare books and manuscripts, and have in the past few years acquired over a dozen early alchemical manuscripts, from a 15th-century book of secrets to Newton's autograph copy of Starkey's *Preparation of the Sophick Mercury for the Philosophers' Stone.* In 2012, I curated an exhibition at CHF entitled "The Alchemical Quest," which featured rare alchemical books of the 16th, 17th, and 18th centuries drawn exclusively from the collections of the Othmer Library and explored alchemy's role as the foundation of modern chemistry. And in 2014, I co-curated an exhibit entitled *Books of Secrets* with CHF's curator of fine art, which examined practices of writing and reading through alchemical manuscripts and paintings. I have already consulted with the *Age of Alchemy* project team and participated in several design charrettes. For the project's prototyping phase, I am excited to bring my expertise as a historian of early modern science, as well as offer support in my role as Curator of Rare Books at the Othmer Library.

I support the Age of Alchemy Game Project proposal, and am looking forward to fulfilling my role as a humanities advisor for the project, should your NEH application be accepted.

Sincerely,

James R. Voelkel, Ph.D.

Curator of Rare Books, Othmer
    Library of Chemical History
Resident Scholar, Beckman Center
    for the History of Chemistry

Frank J. Lee

Education

U.C. Berkeley, Berkeley, CA	Cognitive Science (Summa Cum Laude)	B.A., 1994
CMU, Pittsburgh, PA	Cognitive Psychology	PhD., 2000
CMU, Pittsburgh, PA	Postdoctoral Research Associate	2000-2001

Appointments

Drexel University Philadelphia, PA	Associate Professor Digital Media Department, Westphal CoMAD	2013 – Pres.

- *Director, Entrepreneurial Game Studio*
- *Co-Founder, Drexel Game Design Program*
- *Affiliated Professor, Biomed Engineering*
- *Affiliated Professor, Computer Science*
- *Affiliated Professor, Psychology*

Drexel University Philadelphia, PA	Teaching Professor Department of Computer Science	2009 – 2013
Drexel University Philadelphia, PA	Assistant Professor Department of Cognitive Science	2003 – 2009
RPI Troy, NY	Assistant Professor Department of Cognitive Science	2001 – 2003

Products

- *Skyscraper Tetris*. Public Interactive Light Installation, 2014. Philadelphia PA. The external LED lights of the Cira Centre, a 29-story skyscraper in Philadelphia, were reprogrammed to create an interactive public installation of playable Tetris™ game. It received more than 1500 articles and mentions in the media including the national broadcasts of over 22 countries.

- *Pong on the Cira Centre*. Public Interactive Light Installation, 2013. Philadelphia PA. The external LED lights of the Cira Centre, a 29-story skyscraper in Philadelphia, were reprogrammed to create an interactive public installation of playable Pong™ game. It received more than 300 articles and mentions in the media.

- Çakir N.A., Gass, A.B., Foster, A., Lee, F.J. (accepted). Designing Her Way into Computer Science: Empowering Young Girls Through Identity Exploration. In *European Conference on Educational Research*, Dublin, Ireland

- Çakir M.P., Çakir N.A., Ayez, H., Lee, F.J. (2015). An Optical Brain Imaging Study on the Improvements in Mathematical Fluency from Game-based Learning. In *ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play*. London, United Kingdom.

- Goldman T., Lee F.J., Zhu J. (2014). Using Video Games to Facilitate Understanding of Attention Deficit Hyperactivity Disorder: A Feasibility Study. In *ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play*, Toronto, Canada.

Synergistic Activities

- *Girl Scouts of Eastern Pennsylvania.* Hosted Girl Scout Troops from inner city Philadelphia for workshop on game design to get them interested in programming and technology by making games.
- *Techgirlz Workshop on Game Design.* Advised and hosted Techgirlz workshop on game design for middle school girls. Techgirlz is a local nonprofit group dedicated to getting more girls interested in technology. I served as an advisor and host for their game design workshop.
- *Let's Play PA.* Co-organized with Drew Davidson of CMU and Charles Palmer of Harrisburg University, the first Pennsylvania Consortium on Video Games, created as part of PA JOBS1st PA Initiative with funding from D2PA grant.
- *African American Chamber of Commerce of PA.* Invited by the African American Chamber of Commerce of PA to attend their outreach program to the young African-American professionals as a leader in the region's innovation and entrepreneurship.
- *PA State Legislature Tour.* Organized and hosted eight members of the PA state legislatures along with regional game companies to encourage the discussion between the two groups to discuss ways to accelerate the growth of the creative industry in PA.

Collaborators during the Last 48 Months

- Drew Davidson, Carnegie Mellon Univ.
- Charles Palmer, Harrisburg University
- Brian Smith, Drexel University
- Adrienne Mackey, Drexel University
- Jichen Zhu, Drexel University

- Perit Cakir, MET University, Turkey
- Nur Cakir, Hacettepe Univ., Turkey
- Hasan Ayez, Drexel University
- Arianna Gass, Drexel University

Graduate Advisor

- John Anderson, Carnegie Mellon University.

Postdoctoral Sponsor

- John Anderson, Carnegie Mellon University.

Thesis Advising

- Felicia Tucker, Drexel University
- Craig Benetz, Drexel University
- Quincy Brown, Drexel University

Postdoctoral-Scholar Sponsor

- Nur Cakir, Hacettepe University, Turkey.

Total number of graduate students advised (10)

Total number of postdoctoral scholars sponsored (1)

DREXEL UNIVERSITY
Entrepreneurial Game Studio
ExCITe Center
Expressive and Creative Interaction Technologies

June 6, 2017

Dear Dr. McLeary,

I am a Professor of Digital Media in the Westphal College of Media Arts and Design at Drexel University and the co-founder of Drexel's Game Design Program, ranked as one of the top undergraduate and graduate video game design programs in United States by The Princeton Review. I am also the Founding Director of the Entrepreneurial Game Studio (EGS) at Drexel University, an innovative incubator for student-formed independent game companies that are currently incubating 11 game companies. I also have extensive experience with funded projects. Within the last four years, I have been PI or Co-PI on grants totaling over $2M.

I am pleased to submit this letter of support for The Chemical Heritage Foundation's (CHF) application for funding from the National Endowment for the Humanities' (NEH) Digital Projects for the Public program for CHF's *Age of Alchemy* game. This letter also represents my commitment to serve as an advisor and collaborator for the *Age of Alchemy* Game Project, in my position as Director of the Entrepreneurial Game Studio. This project draws upon recent reinterpretations by historians of the role of alchemical practice in creating both knowledge about the natural world and the modern scientific enterprise and will be a valuable contribution both to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern science and to the field of meaningful play.

My own work and creative interests closely align with CHF's project, in particular using digital experience to engage the public. In 2014, for the public installation project, *Skyscraper Tetris*, I reprogrammed the LED lights of the Cira Centre, a 29-story tall skyscraper in Philadelphia, to create an interactive multi-player game of Tetris. We had over 2500 people come to the 2-hour event and had mentions in over 1500 articles and broadcasts including the national broadcast news of over 22 countries. An analysis by a third-party media analytics firm estimated that based on the media coverage the project had over 2.2 Billion views.

In closing, please accept this letter as proof of my intent to serve as an advisor and collaborator for CHF's *Age of Alchemy* Game Project. I am pleased to bring my years of expertise in game design and game-based learning to my role as an advisor and collaborator for this project. I am looking forward to fulfilling this capacity, should your NEH application be accepted.

Sincerely,

Frank Lee

--
Frank J. Lee, Ph.D.
Professor of Digital Media
Founding Director, Entrepreneurial Game Studio
Co-Founder, Drexel Game Design Program
Westphal College of Media Arts and Design, Drexel University
Entrepreneurial Game Studio Website: http://egs.excite.drexel.edu/
Personal Website: http://www.pages.drexel.edu/~fjl24/

"Polygon's 50 Admirable Gaming People, 2014"
"Hacker of the Year by Philly Geek Awards, 2013"
"The Smartest People in Philadelphia, 2012"

Thomas M. Sharpe

www.sharpedesigns.net

tom@gossamer-games.com

Education

Drexel University   Philadelphia, PA
Bachelor of Science in Game Art & Production   Graduated: June 2016
                                                                                          Cum Laude

Honors and Awards

13th International Mobile Gaming Awards, Nominee
2017 Intel University Games Showcase, Participant
2016 Rensselaer GameFest, Excellence in Mobile Gaming
Dean's List, Drexel University, Spring 2013 – 2014
Dean's Scholarship, Drexel University, 2012 – 2014

Skills

Game Engines: Unity, Unreal 4, GameMaker: Studio
3D Media Software: Maya, MotionBuilder, Mudbox; Pro Tools
Other Software: Adobe Creative Cloud, Pro Tools, GanttProject, Trello, Source Tree, Microsoft Office
Scripting Languages: C#, C++, HTML5

Work Experience

Gossamer Games LLC   Philadelphia, PA
Director   November 2014 to Present
• Co-founded and incorporated a limited liability company
• Director for Gossamer's debut game Sole
• Garnered international media attention for Gossamer Games
• Raised over $10,000 in funding for the company's first project

Entrepreneurial Game Studio   Philadelphia, PA
EGS Co-op   April to September 2015
• Design front-end user interfaces for social mobile games
• Create promotional material for products and upcoming events
• Generate design documentation for a mobile game production
• Facilitate administrative operations across the organization

Project Experience

The Knowledge We Seek   Drexel University
Technical Director   February to March 2014
• Directed the art and technology development for a cross-platform VR puzzle game
• Implemented and optimized art assets for mobile and VR platforms
• Designed and implemented three cooperative puzzles using experimental technology
• Organized, facilitated, and documented dozens of playtesting sessions

Activities

• Member, Entrepreneurial Game Studio, 2014 – Present
• Member, International Game Developers Association, 2014 - 2015

Gossamer Games LLC
3230 Market Street
403 Pearlstein, Baiada Institute
Philadelphia, PA 19104

Dr. Erin McLeary, Museum Director
The Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106

June 6, 2017

Dear Dr. McLeary,

I am pleased to submit this letter of support for The Chemical Heritage Foundation's application for funding from the National Endowment for the Humanities' (NEH) Digital Projects for the Public program for CHF's *Age of Alchemy* game. As the Director and Co-Founder of Gossamer Games LLC, this letter also represents Gossamer's commitment to work as the Digital Media Team for the *Age of Alchemy* Game Project. This project will be a valuable contribution both to CHF's continuing efforts to interpret and make accessible their artworks and manuscripts related to the history of early modern science and to the field of meaningful mobile gameplay design.

Gossamer Games LLC, which was founded in 2015 and emerged out of the Entrepreneurial Game Studio at Drexel University, creates ambitious aesthetic-driven experiences that explore games as an empathetic and expressive art form. Our mission is to make accessible games that allow players to create, explore, and perform inside imaginative environments. As creative director, one of my primary focuses is creating immersive game designs that abstract our everyday thoughts and feelings. The Gossamer team also includes Nina Delucia, 3D/Texture Artist and Vincent De Tommaso, Environment Artist. Our debut game *Sole* was recently nominated for the 13th International Mobile Gaming Awards, selected to participate in the 2017 Intel University Games Showcase, and won multiple awards at the 2016 Rensselaer GameFest. We are thrilled to bring our experience designing mobile games to the *Age of Alchemy* project, which we see as a tremendous opportunity to further our mission in diversifying the mobile game marketplace with substantive aesthetic-driven gameplay experiences.

In closing, please accept this letter as proof of Gossamer Games' intent to work as the Digital Media Team for CHF's *Age of Alchemy* game project. We look forward to collaborating on this project should your NEH grant application be accepted.

Sincerely,

Thomas Sharpe, Director
Gossamer Games LLC

6. WORK SAMPLE

Gossamer Games Work Sample:

Sole: Sole is an abstract, aesthetic-driven mobile adventure where you play as the only source of light in a world shrouded in darkness. Wander through desolate environments, painting the land with light as you discover its mysterious past. Explore the remnants of great cities and uncover the history of an ancient civilization on your journey to restore life to an abandoned world. This highly anticipated debut title from Gossamer Games has been recognized as one of the top mobile games by the 13th International Mobile Gaming Awards.

URL: http://gossamer-games.com/games/sole/

CHF Work Sample:

Chemcrafter iPad app: Chemical reactions don't just happen—you have to make them happen. ChemCrafter lets you build your own lab to run fun and creative experiments. Use the Chem-o-Convertor to measure energy released and gain points that unlock new experiments, equipment, and chemicals. Use your new supplies to craft more gases, liquids, and solids. As your strategy guides you through experiments with water, acids, and salts, you'll create surprising color changes, encounter fire and smoke, release various gases, and shatter equipment as your achievements earn you an impressive set of trophy-room badges.

URL: http://assets.chemheritage.org/ChemCrafter/

Budget Form

NATIONAL ENDOWMENT FOR THE Humanities

Applicant Institution: *Name*
Project Director: *Name*
Project Grant Period: *mo/day/year through mo/day/year*

click for Budget Instructions

	Computational Details/Notes	(notes)	Year 1	(notes)	Year 2	(notes)	Year 3	Project Total
			01/01/2018-12/31/2018		01/01/20__-12/31/20__		01/01/20__-12/31/20__	
1. Salaries & Wages								
Project Director (Erin McLeary)	10% Annual salary		$▮					$▮
Project Manager (Charles McGhee Hassrick)	20% Annual salary		$▮					$▮
Content Specialist (Elisabeth Berry Drago)	40% Annual salary		$▮					$▮
Content Specialist (Nicole Cook)	30% Annual salary		$▮					$▮
								$62,697
2. Fringe Benefits								
Project Director (McLeary)	Payroll taxes (8%) and benefits (20%)		$▮					$▮
Project Manager (McGhee Hassrick)	Payroll taxes (8%) and benefits (20%)		$▮					$▮
Content Specialist (Berry Drago)	Payroll taxes (8%) and benefits (20%)		$▮					$▮
Content Specialist (Cook)	Payroll taxes (8%) and benefits (20%)		$▮					$▮
								$17,555
3. Consultant Fees								

Entrepreneurial Game Studio Director (Dr. Frank Lee)	Summer Salary and Fringe Benefits	70%	$▉						$▉
Entrepreneurial Game Studio Program Manager (to be named)	Salary and Fringe Benefits: $▉	10%	$▉						$▉
Evaluator (Kate Haley Goldman)	Consulting Fees		$▉						$▉
Advisor honoraria	<mark>7 advisors @ $500/ person</mark>		$3,500						$3,500
									$36,824
4. Travel									
Evaluator (Haley Goldman)	3 trips DC to Philadelphia; $182/trip Amtrak: Hotel $170/trip; per diem $60/day x 2 days; $40 taxis, parking, misc.		$1,536						$1,536
Advisor (Bilak)	2-day, 1 night trip; $100 trains New York to CHF; $302 and $376 hotel nights and $64 meals per diem	x 2 trips	$667						$667
Advisor (DeWitt)	3-day, 2 night trip; $300 flights Norfolk, VA to CHF; $302 and $376 for 2 hotel nights and $64 meals per diem	x 2 trips	$1,406						$1,406
Advisor (Moran)	3-day, 2 night trip; $500 flights Reno, NV to CHF; $302 and $376 for 2 hotel nights and $64 meals per diem	x 2 trips	$1,806						$1,806

Advisor (Newman)	3-day, 2 night trip; $400 flights Bloomington, IN to CHF; $302 and $376 for 2 hotel nights and $64 meals per diem:	x 2 trips	$1,606						$1,606
Advisor (Principe)	2-day, 1 night trip; $100 trains Baltimore to CHF; $302 and $376 hotel nights and $64 meals per diem	x 2 trips	$667						$667
Advisor (Schaller)	3-day, 2 night trip; $200 flight St. Paul, MN to CHF; $302 and $376 for 2 hotel nights and $64 meals per diem:	x 2 trips	$1,206						$1,206
									$8,894
5. Supplies & Materials									
6. Services									
Gossamer Games	Design and development fees (see itemized attachment)		$70,000						$70,000
									$70,000
7. Other Costs									
CHF Conference Center use, workshop 1 (remote)	2 hour meeting		$325						$325

CHF Conference Center use, Mid-Point Advisory Meeting (remote)	$325/hour for 2 hours		$325					$325
CHF Conference Center use, workshop 2 (in person)	$800/half day for 4 hour meeting and prototyping session		$800					$800
								$1,450
8. Total Direct Costs	**Per Year**		**$197,420**		**$0**		**$0**	**$197,420**
9. Total Indirect Costs								
	Per Year				$0		$0	
10. Total Project Costs		(Direct and Indirect costs for entire project)						**$197,420**

11. Project Funding	**a. Requested from NEH**	Outright:	$100,000
		Federal Matching Funds:	$0
		TOTAL REQUESTED FROM NEH:	**$100,000**
	b. Cost Sharing	Applicant's Contributions:	$97,420
		Third-Party Contributions:	$0
		Project Income:	$0
		Other Federal Agencies:	$0
		TOTAL COST SHARING:	**$97,420**
12. Total Project Funding			**$197,420**

Total Project Costs must be equal to Total Project Funding ---->   ($197,420   = $197,420   ?)

Third-Party Contributions must be
greater than or equal to Requested Federal Matching Funds ---->   ($0   ≥ $0   ?)

8. IMAGES AND LINKS TO OTHER ASSETS

Follow the URL links below to view images, renderings, production art, and videos and to listen to audio assets associated with *Age of Alchemy*. You may need to copy and paste the links into your browser.

1. Game Environment 360: A movie file of a 360 degree view of one of the alchemist workshops modeled in 3D

   (b) (4)

2. Game Renderings: Several rendered views of a 3D designed alchemist workshop and one image showing the painting and 3D modeled workshop

   (b) (4)

3. Period Music: Two pieces of period music and the emblems from *Atalanta fugiens* with which they are associated

   (b) (4)

4. Select Source Art: Higher definition files of some of the artworks from which the 3D modeled environments are being based

   (b) (4)

AGE OF ALCHEMY:
THE GOLDSMITH'S DAUGHTER

AN EXPLORATORY GAME DESIGN DOCUMENT

GOSSAMER GAMES

CHF

DREXEL UNIVERSITY
Entrepreneurial
Game Studio
ExCITe Center
Expressive and Creative Interaction Technologies

DOCUMENT OVERVIEW

This design document serves as a conceptual framework for *Age of Alchemy: The Goldsmith's Daughter*, an interactive, first-person, mobile adventure game. *Age of Alchemy* places players in London in the mid-17th century, during the "Golden Age" of alchemy; a key period in alchemy's development as an interdisciplinary experimental pursuit.

The following content represents the project's preliminary game design direction. During this prototyping phase, Gossamer Games in partnership with the Chemical Heritage Foundation (CHF) and the Entrepreneurial Game Studio (EGS) at Drexel University will develop and test playable mechanic demos along with an interactive game storyboard as detailed in the application narrative. The ideas in this document serve as the foundational vision for the project and will undergo several iterations in response to data gathered from monthly playtesting sessions and evaluation surveys with the public, our scholarly advisory team, and CHF humanities content specialists.

TABLE OF CONTENTS

1. NARRATIVE SUMMARY

HUMANITIES THEMES:

Age of Alchemy will create a playful and experimental path to understanding the goals and cultural importance of alchemical practice in Europe during the 1600s, on the eve of the scientific revolution. Players will unde go an experience that captures the creative essence of alchemy's quest for natural knowledge, structured around three core humanities themes:

ALCHEMY AS CROSS-DISCIPLINARY ART

Alchemy was a cross-disciplinary early modern practice dedicated to understanding the natural world, and thus crucial to histories of the science and the arts.

DIVERSITY OF ALCHEMY'S PRACTITIONERS

Alchemy was a pursuit practiced by individuals who ranged from elite "experts" to working artisans. Alchemists existed at different levels of society, traveled across geographic boundaries, and worked in and for many different communities.

WOMEN'S NETWORKS OF ALCHEMICAL PRACTICE

Women's contributions to alchemy have long been overlooked, but recent historical research has shed light on their important roles as practitioners and theorists.

Early modern alchemists were engaged in a wide array of enterprises, from mining and metalworking to dye and pigment manufacturing, to the production of chemical medicine and the study of natural phenomena. Alchemical treatises circulated knowledge across a broad spectrum of society, from artisans and tradesmen to scholars and princes. Though long mischaracterized and little understood, alchemy continues to spark the public imagination. The mystery and romance of alchemy invites curiosity, but its realities are far more compelling. *Age of Alchemy* seeks to put CHF's interrelated collections of paintings, prints, and manuscripts in dialogue with one another in an accessible format, allowing players to step into the past and experience early modern, empirical knowledge-making.

1) ALCHEMY AS CROSS-DISCIPLINARY ENDEAVOR

Players of *Age of Alchemy* will experience a past world in which alchemists were not only chemical workers, but often authors and poets, composers, theorists and theologians, physicians, artists, and artisans. Their work encompassed technical skill, research and writing, experimental and creative labor. Activities that are today divided into the fields of philosoph , medicine, mining, metallurgy, and industrial chemistry could all fall under the early modern rubric of alchemy (also called "chymistry"). *Age of Alchemy* will present the diversity of alchemical pursuits and invite players to consider an early modern worldview in which art and science are inextricably connected.

Age of Alchemy has five levels, each of which centers on a specifi alchemical experiment and key figure. These levels explore the different practices connected with alchemy during the 1600s, including chrysopoeia (attempts at gold-making), distillation (the art of reducing a substance to essence), iatrochemistry (the production of chemical medicines), assaying (the evaluation and working of metallic ores), and urinoscopy (the medical study of urine for diagnosis). The combination of immersive imagery and hands-on experimentation emphasizes early modern artistic portrayals of alchemy as more than pictures of a vanished world: players will find in this art pathways to experience a shared cultural history of artistry and experimental ideas.

The game explores art and alchemy's shared practical relationship in the early modern period, as many artists' materials were manufactured via alchemy, including pigments and dyes, effects in glassmaking and printmaking, and metal alloys for sculpture and ornament. In turn,

Art and science mingle in "*The Alchemist*," by Mattheus van Helmont (1623-1679), CHF collections.

artistic representations of alchemy which popularized and familiarized this emerging empirical science will be explored as players literally enter the setting of many of CHF's alchemical paintings.

Crucially, the rendered environments of the game will be drawn from CHF's collections of paintings and works on paper. The artistic portrayals of alchemists are central to the game's interpretive framework. From serious to satirical representations, the visual culture of the 1600s in Europe experienced a profusion of alchemical imagery, particularly in the Netherlands, Germany, and England. Paintings and prints of alchemists are by no means "photographic snapshots" of early modern alchemical practice. Neither are they exclusively negative indictments of alchemy. These images, because of their diversity and artistic license, offer insight into the different perspectives that early modern people held about alchemy. Players will be invited to shift their perspective on alchemy as their visual experience shifts from virtual room to virtual room and they learn about the often conflicting viewpoints about alchemy that were held by historical actors in the social world of Europe in the 1600s.

2) DIVERSITY OF ALCHEMY'S PRACTITIONERS

Players will explore *Age of Alchemy*'s historical and interpretive content through five successive levels of gamepla , each advancing the overarching narrative of Viola's quest to establish herself as an alchemist. Through her viewpoint, players will experience the environments of alchemical practice in 1600s England and the interconnected practices of art-making, craft, medicine, philosophy, and music. Recent research on the history of alchemy has revealed the diversity of its practitioners, theorists, and patrons. The most public and well-known alchemical figures in the early modern era have, up to very recently, been the royal and elite patrons who invested spectacular resources in large, factory-like laboratories.

An alchemist works in the background of this middle- class family kitchen space in this work by Thomas Wijck (1616-1677), CHF collections.

Yet, middle and working-class individuals and groups also practiced alchemy in much more modest domestic contexts. Alchemical experimentation could offer a way to earn income and gain reputation for people on the margins of European society. More recent thinking about the history of alchemy, stemming from work by scholars Moran, Principe, and Smith, has expanded to reconsider artisans and craftspeople as critically engaged in alchemical pursuits, particularly in professions such as goldsmiths and vernacular apothecaries. Players, through Viola's narrative arc, will encounter sites of domestic or "household" alchemy, where husbands, wives, and children worked side-by-side in the preparation of alchemical materials and in conducting experiments. By focusing on a merchant-class central character, *Age of Alchemy* will allow players to traverse the different levels of society in which alchemy operated, from humble artisanal shops to royal courts. Through the barriers that the Viola faces, players will gain insight into the classed, racialized, and gendered contexts for alchemical practice.

3) WOMEN'S NETWORKS OF ALCHEMICAL PRACTICE

The character of Viola invites game players to delve into the still little-understood and under-interpreted role of women alchemical practitioners. By nature of its trade secrets and focus on clandestine knowledge, alchemical pursuits could generate intimate communities of knowledge in which women could converse with, debate, and collaborate with other women and men. Like much scholarly research, however, the truth of women's participation in alchemical work has yet to filter into the popular imagination. *Age of Alchemy* will help to bridge this gap by offering an immersive and accessible story rooted in humanities scholarship.

Players will have the opportunity to read and gain valuable information from actual early modern alchemical texts, both practical and symbolic. The game breaks down the complicated and complex allegories of alchemical symbolism through exploration of philosophical alchemical books. One of the philosophic explorations will feature the significant gendered elements of some alchemical symbolism. Certain theories regarding the alchemical quest to "perfect" nature displayed uniquely fluid concepts of gende . In conflict with older Aristotelian concepts of gender that portrayed the male as the highest and most perfect form, many early modern alchemical treatises described the merging of male and female halves together as necessary in creating a perfected humanity and a purified nature

Artists and manuscript illustrators adopted a wide variety of male and female forms to picture these processes, many of which will be featured in the game. As Viola advances in her journey, players will interact

In a modest workshop, husband and wife collaborate on an experiment in this copy after a painting by David Ryckaerts III (1612-1661), CHF collections.

with the gendered aspects of alchemical philosophical and spiritual symbolism as well as the practical position of female alchemists in the mid-1600s.

This focus on a female character also allows us to showcase artworks from the CHF collections that depict women engaged in alchemical practice, from reading recipes, to manipulating materials, to supporting the household laboratory or workshop. At times, women also play the role of the voice of reason in satirical pictures depicting alchemy as a fool's errand. In *Age of Alchemy*, we will be able to nuance these naturalistic or humorous artistic portrayals of women's involvement in alchemy from a historically grounded perspective. The game will explore questions such as why wives were often pictured as disapproving of their husband's alchemical pursuits and the household labors and financial hardships that sometimes lay beneath the search for alchemical success.

DESIGN METHODOLOGY

To incorporate these themes, *Age of Alchemy* has adopted several key game design principles. To reinforce the role-playing nature of the game's narrative and build immersion, players will see the world from a first-person perspective. This will allow players to step into the game world and explore and discover the detailed environments as if they were actually there.

The emotional immediacy of first-person games supports our desire for *Age of Alchemy* to build empathy for past historical actors and develop an understanding of the early modern mindset—one that believed in both empirical research and transmutative possibility. Individuals who engaged with alchemy weren't simply fools or greedy charlatans; they were entrepreneurs, experimenters, teachers, and artists. Players will have the opportunity to interact with these characters by engaging in conversations and hearing their unique perspectives.

Age of Alchemy uses a branching narrative tree that engages players in making choices that impact later gameplay. Throughout the game, players are prompted to make decisions that influence the progression of their avatar Viola. For example, early in the game, players will make a decision that may lead to Viola acquiring her mother's book of secrets. This book can be used in later levels to diagnose medical illnesses. Should the player not collect the book, they must find an alternate method of obtaining the information. By allowing players to make decisions about Viola's actions in the game, they create a sense of intimacy that builds empathy with the protagonist while exploring the moral and intellectual dynamics of the period.

While interactions with other characters support the narrative themes of the game, the majority of the play experience is comprised of exploring the game world. Drawing inspiration from classic adventure game design, players are tasked with finding and using objects scattered around each scene. This approach encourages players to perform a close examination of their surroundings as each space has gameplay utility instead of simply acting as a backdrop for the game's story.

Unlike many traditional game designs, there is no explicit failure or lose conditions in *Age of Alchemy*. Instead, players are invited to explore and experiment at their own pace. Though players are required to complete a specific series of actions to progress through the game, there are no explicit fail states that cause players to lose progress. This reinforces and encourages players to immerse themselves in the game world without pressure or danger.

NARRATIVE OVERVIEW

STORY PROGRESSION

Viola is the game's fictional protagonist. She is a young woman living in London during the mid-1600s. The daughter of a goldsmith, Viola has grown up immersed in workshop experimentation and the alchemical pursuits related to metallurgical practice. Viola longs for the day she can take over her father's shop and test out her own alchemical ideas. At the start of the game, Viola discovers that her father is planning to marry her off to a man who will then inherit the goldsmith workshop, leaving her cut off from any avenues to advance her own alchemical interests. Taking huge risks, Viola decides to trick her father, escape from her impending marriage, and set out on a series of quests to pursue becoming an alchemist in her own right, encountering many obstacles along the way. In *Age of Alchemy*, the player assumes the role of this budding young alchemist and follows her journey through the golden age of alchemy.

NARRATIVE AGENCY

The story of *Age of Alchemy* has been designed as a narrative tree that provides players with agency. Throughout the game, players are prompted to make decisions about overcoming various obstacles that influence the progression of their avatar Viola. This use of agency creates a sense of intimacy that builds empathy with the protagonist while exploring the moral and intellectual dynamics of the period.

CONTENT STRUCTURE

Age of Alchemy is structured as collection of vignettes modeled after the source paintings and historical events. The content of the game will be divided into five levels, each centering around a specific alchemical experiment and key figure. The gameplay and narrative content have been designed modularly and allow for further expansion to explore additional themes and areas of alchemy given additional funding and resources.

LEVEL 1 NARRATIVE FLOW

Context:
Your father has planned an arranged marriage against your will. You decide to create a sleeping draught that will allow you to steal your father's notebook and kick start your journey in becoming a renowned alchemist.

Go to The Apothecary to seek assistance

The Apothecary is sold out and too busy to make more sleeping draught

Ask for the formula to make it yourself

The Apothecary refuses to share trade secrets

Offer a page from your

YES → The Apothecary agrees to help you in exchange for your father's secrets

NO

Spend the day at home to search for your mother's

Book: Book of Secrets
Obtains mother's household alchemy book

Go to The Apothecary for ingredients

Purchase the ingredients and return home

Book: The Art of Distillation
Player given ingredients, formula, and access

Exploration Phase 1
Search father's workshop for a retort and additional ingredients

Puzzle 1
Player brews the draught at home in workshop

Puzzle 2
Pour draught into father's drink and steal notebook

Player returns to the Apothecary, hands over the page, and then leaves town

Level 1 Complete
+Apothecary's recommendation
-Lost formula from father's notebook
-Don't acquire Mother's book of secrets

Search father's workshop for a retort and additional ingredients

Player brews the draught at home in workshop

Player leaves town

Level 1 Complete
+Mother's book of secrets
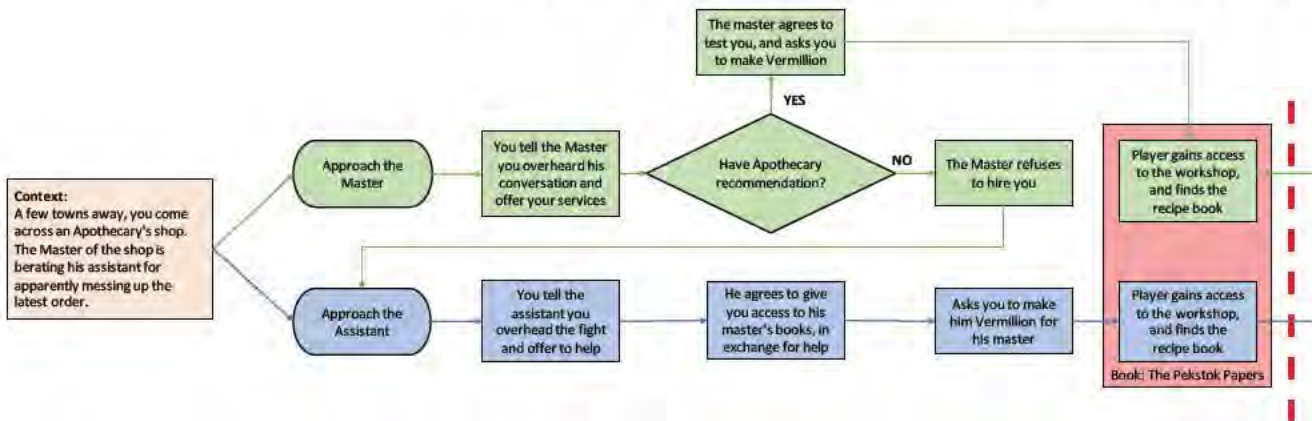-Don't acquire The Apothecary's recommendation

LEVEL 1 NARRATIVE SYNOPSIS

Viola's father has planned an arranged marriage against her will! Eager to begin her journey to become a renowned alchemist, she decides to create a sleeping draught that will allow her to steal her father's notebook of trade secrets and leave home. At the start of the level, the player is prompted with a decision to either stay home to look for a recipe for a sleeping draught, or go straight to an apothecary to seek help. If the player chooses to go to the apothecary first, they will have the option to barter with him for the sleeping draught recipe, with a promise to return with a page from their father's notebook, or refuse and return home to search the house. If the player chooses to search the house, they will find their mothe's notebook containing the recipe and will go to the apothecary to acquire the ingredients. Upon their return home, the player will have to decipher the writing in the recipe, then collect the necessary equipment from their father's workshop to brew the sleeping draught. The player will then administer the draught to their father, gaining his book. If the player opted to barter with the apothecary, they will then lose one recipe from the book.
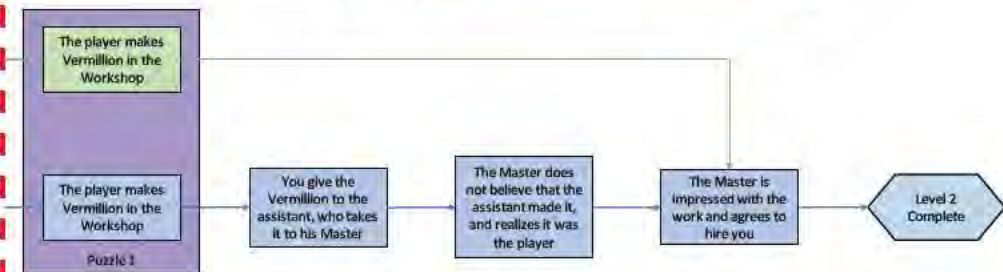
LEVEL 2 NARRATIVE FLOW

Context:
A few towns away, you come across an Apothecary's shop. The Master of the shop is berating his assistant for apparently messing up the latest order.

The master agrees to test you, and asks you to make Vermillion

Approach the Master

You tell the Master you overheard his conversation and offer your services

Have Apothecary recommendation?

YES

NO

The Master refuses to hire you

Player gains access to the workshop, and finds the recipe book

Approach the Assistant

You tell the assistant you overhead the fight and offer to help

He agrees to give you access to his master's books, in exchange for help

Asks you to make him Vermillion for his master

Player gains access to the workshop, and finds the recipe book

Book: The Pekstok Papers

The player makes Vermillion in the Workshop

The player makes Vermillion in the Workshop

Puzzle 1

You give the Vermillion to the assistant, who takes it to his Master

The Master does not believe that the assistant made it, and realizes it was the player

The Master is impressed with the work and agrees to hire you

Level 2 Complete

LEVEL 2 NARRATIVE SYNOPSIS

Viola travels to a distant town, and begins searching for employment. Upon arriving at the town's apothecary, she sees the master berating his assistant outside the shop. She overhears that the assistant botched an order for pigment for an important client, and the master is furious. The player then has a choice to either approach the master or the assistant and offer their services. If the player chooses to approach the master, Viola offers her services as a replacement for his incompetent assistant. If the player has the recommendation from the pharmacist, the master will reluctantly agree to hire her. However, if the player does not, the master will not believe Viola's credentials and refuse. The master must then leave to take care of other business, and leaves the player or his apprentice in charge of the shop, depending on if he hired the player or not. If the player chooses to approach the assistant from the start, or was rejected by the master, Viola will offer her assistance to the apprentice in an effort to get him back into his master's good graces. In exchange, Viola requests access to the apothecary's notes and books, to which the apprentice agrees. Either way, the player is tasked with making vermillion before the master returns. The player is now free to explore the apothecary's workshop, find the relevant manuscripts, ingredients, and equipment, and create the pigment. Upon the master's return, if Viola was hired from the start, the master will be pleased and agree to hire Viola as his new apprentice. If the player assisted the old apprentice, the assistant will present the vermillion to the master, who after inspecting it, will not believe it was the assistant's work. The master will demand the truth, and the apprentice will reveal that Viola made the vermillion. After dismissing the apprentice, the master will agree to hire Viola as his assistant.

LEVEL 3 NARRATIVE FLOW
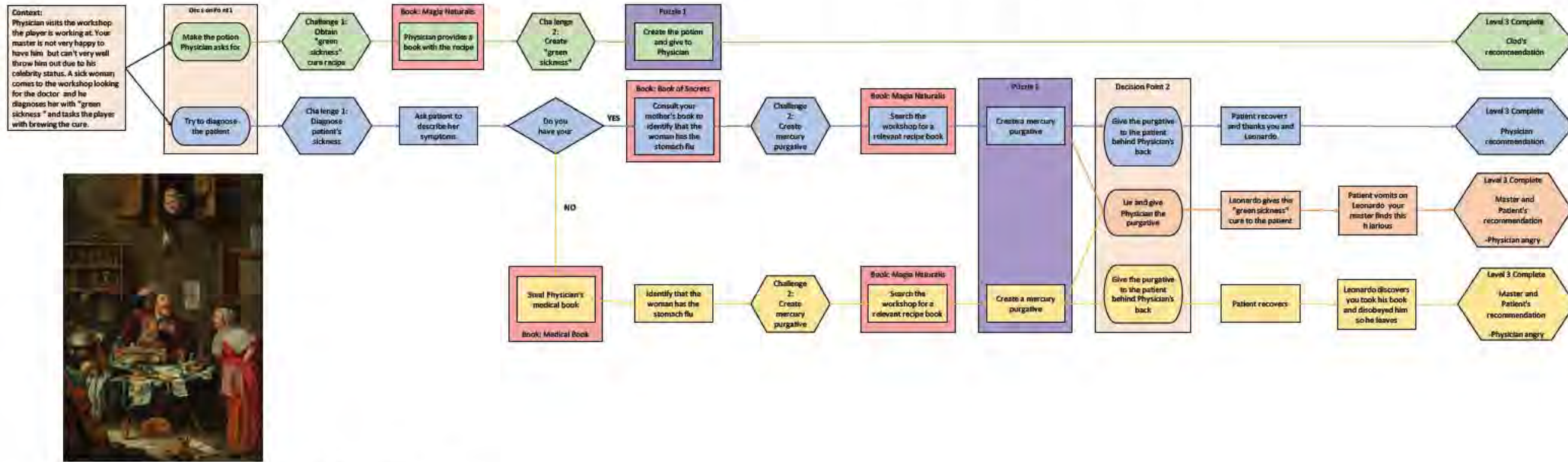
LEVEL 3 NARRATIVE SYNOPSIS

A well known physician visits the Apothecary shop where Viola works (the physician's character will be tested during the prototype phase, and will draw on historical figures such as Frederick Clod, 1625-ca.1661). Viola's master is unhappy about the visit, as he is afraid the physician will be a distraction from his work, but cannot turn away such a prestigious visitor. A female patient visits the apothecary shop, and complains of malaise, nausea, and has a greenish pallor. The physician diagnoses this patient with "green sickness" (a sickness commonly associated with young virginal women and historically linked with concepts of "lovesickness" and women's sexuality). Viola is faced with the decision to either go along with the physician's diagnosis, or choose to seek a diagnosis and cure the patient on her own. If players trust the physician's diagnosis, they are given the recipe for and must brew a green sickness potion to administer to the patient. Doing this will please the esteemed physician, but administering the potion will cause the patient to become more ill. If players choose to diagnose the patient themselves, they will need to locate a book to assist them in identifying the disease. If players have their mother's book of secrets from Level 1, they can recognize the patient's ailment as a stomach flu. If not, players must take one of the physcian's books to reach the same conclusion. Players will then have the opportunity to create a mercury purgative and a choice to either present it to the physician and claim it is what he asked for, or to administer it to the patient directly. Players' choice to trust the physician's diagnosis, strike out on their own, steal his books, or give the purgative directly to the patient will influence the physician s reaction and determine whether or not they acquire his recommendation at the end of the level.

LEVEL 4 NARRATIVE FLOW
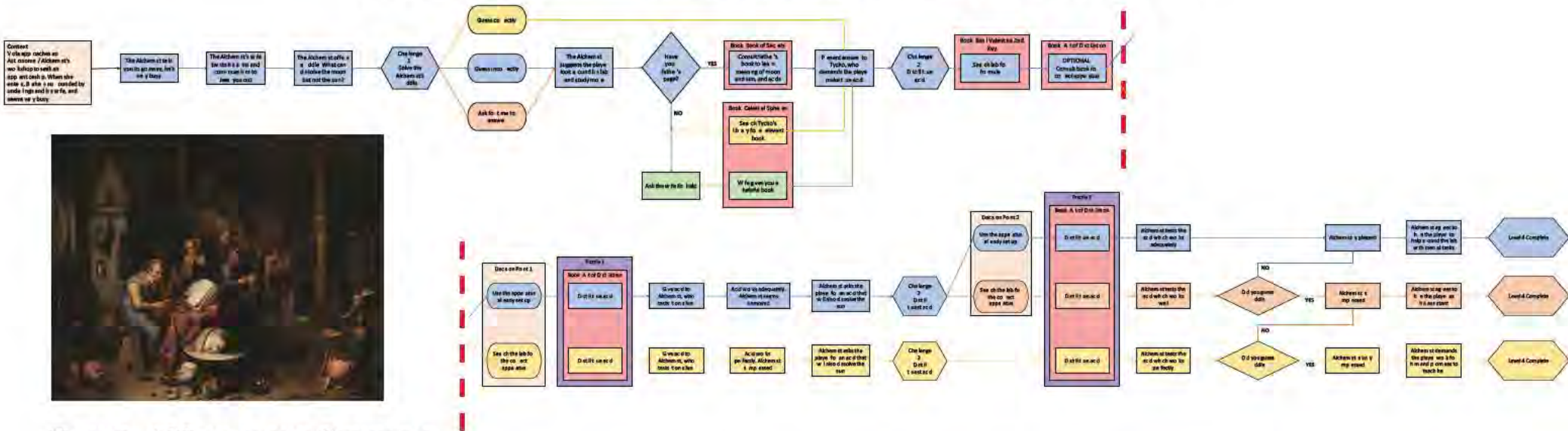
LEVEL 4 NARRATIVE SYNOPSIS

Having learned all she could while working for the Apothecary, Viola travels to the city in search of new opportunities. There, Viola comes upon the workshop of a famous astronomer and alchemist and asks for a job. The Astronomer/Alchemist refuses to offer a test until his wife intervenes. His wife plays upon that experience in order to persuade him to have sympathy for Viola and give her a chance to take the test. Either way, he poses a riddle to Viola as a test: "What can dissolve the moon, but not the sun?" Players are now free to explore the workshop, consult their notes, or guess the answer. If players did not lose a page of Viola's father's notebook to the pharmacist in Level 1, players will have the answer in their notebook. Otherwise, players will have to search the workshop for the manuscript with the answer, or ask the Astronomer/Alchemist's wife for further assistance in locating the book. Once the player presents the Astronomer/Alchemist with the correct answer, "True Acid," he will demand that the player produce this chemical. The player will then search the workshop to find Basil Valentine's Second Key, which they can interpret to obtain the formula for True Acid. After consulting the *Art of Distillation*, a text acquired in the first level, the player will have all the information they need to create True Acid in the workshop. The Astronomer/Alchemist's workshop will have a distillation apparatus ready to use; however, consulting the *Art of Distillation* will reveal there is a more efficient equipment option. The player has the choice to use the equipment that's already set up, or search the workshop for the better apparatus. This choice will affect how impressed the Astronomer/Alchemist is at the end of the level, which will be reflected in the tone of his responses to players. Upon presenting the True Acid to him, players will be presented with another riddle. The Astronomer/Alchemist demands, "Now make me something that can dissolve the sun too!" Again, players can consult Basil Valentine's Key for the recipe for Aqua Regia, and then proceed to make it. When presented with the Aqua Regia, the Alchemist/Astronomer is impressed and agrees to hire the player as an assistant.

LEVEL 5 NARRATIVE FLOW
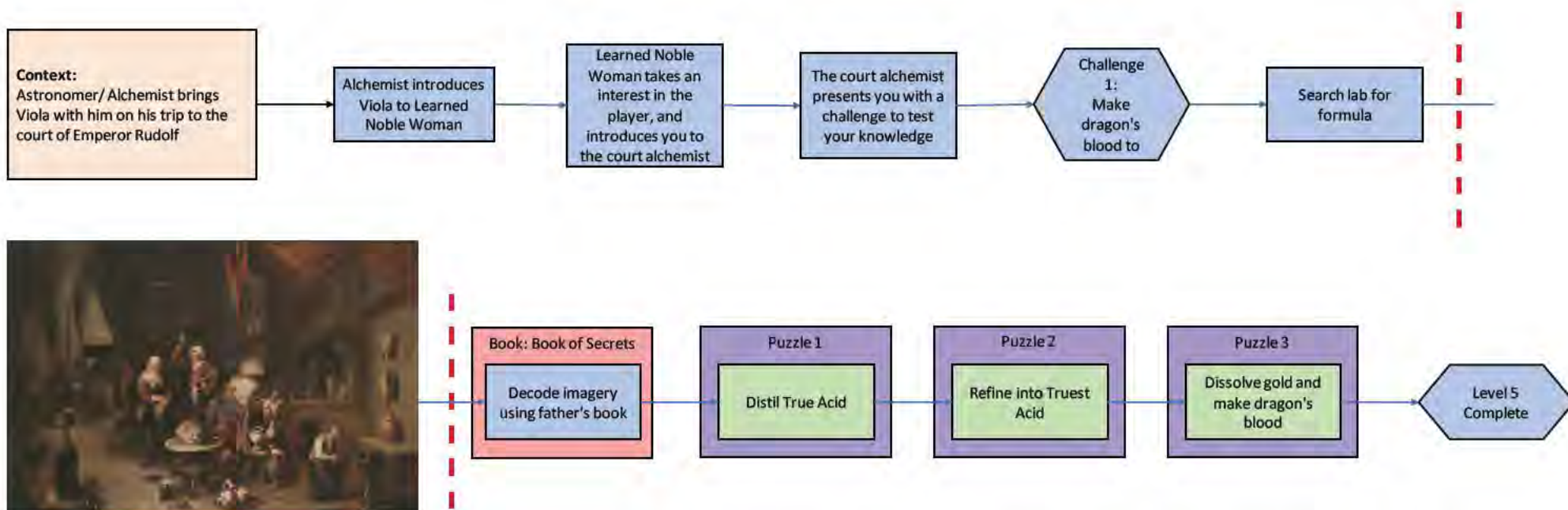
LEVEL 5 NARRATIVE SYNOPSIS

The Astronomer/Alchemist from Level 4 brings Viola with him on a trip to a courtly setting outside of London. The final geographic location will be tested during the prototype phase, drawing on examples such as the court of Christina (1626-1689), formerly Queen of Sweden, who set up a court in Rome after abdicating her throne, or the court of Frederick III of Denmark (1609-1670), who employed court alchemist Giuseppe Francesco Borri. At the courtly setting, the Astronomer/Alchemist introduces Viola to a Learned Noble Woman, who is interested in alchemy and takes a liking to Viola. The Learned Noble Woman introduces Viola to the Court Alchemist, and asks him to test the player. The court alchemist tasks the player with the seemingly impossible test of creating Dragon's Blood, one of the ingredients for the philosopher's stone. Using the knowledge acquired through the previous levels, along with Basil Valentine's Third Key, which can be found in the court workshop, the player has all the information they need to create Dragon's Blood. After presenting the item to the alchemist and the Learned Noble Woman, she agrees to take the player on as one of her handmaids, so that the player may assist her with her alchemical experiments.

2. USER EXPERIENCE

USER EXPERIENCE OBJECTIVES

Moving beyond the scholarly page, and outside museum walls, *Age of Alchemy* offers a new approach to telling the story of alchemy and its impact on our world. The five levels of the game will bridge the history of scientific inquiry with humanities approaches drawn from art history and material culture, to generate a new, accessible, and creative means of engaging public audiences with vital stories of inspiration, transformation, and experiment. Through Viola's eyes, players will be plunged into the diverse arenas of laboratories, workshops, apothecaries, and homes, all sites of material experimentation and practice in England during the mid-1600s.

The game is structured to accommodate varied levels of knowledge, interest, and attention, utilizing a robust help system to aid in the step-by-step learning, decoding, translating, and problem-solving required to advance in the game. CHF and Gossamer Games' goal is to use this prototype phase to determine the aspects of Viola's narrative that players find most compelling, using the results of testing to refine th module's narrative arc and details.

Age of Alchemy utilizes the strengths of the video game medium by inviting players to interact directly with source materials through play, gaining a new understanding of the subject through storytelling and roleplay, and exploring details environment that are just as striking as their reference artworks. The various actions involved in conducting alchemical experimentation translate naturally to a medium where discovery through play serves as the core appeal.

KEY DESIGN DECISIONS

In-Game Hints
Experimentation and exploration lie at the heart of *Age of Alchemy*'s gameplay. As such, an in-game hint system is essential to ensuring players do not quit out of frustration or confusion. Drawing inspiration from *The Room* game franchise, *Age of Alchemy* includes an in-game hint system that provides players with incremental clues for each step of the sequence found in Viola's journal. These clues are delivered in increasingly straightforward ways, gently pushing players in the right direction without stripping their sense of satisfaction in discovering the correct solution. In this way, players of varying skill levels will have an evenly paced gameplay experience filled with surprising discoveries and "aha!" moments.

Novel Device Interactions
One of the core game dynamics in *Age of Alchemy* is experimentation. To ensure interactions with laboratory equipment feel tactile and satisfying, the game employs novel interfaces for object use and manipulation. For example, to pour liquid from one vessel to another, players will need to physically rotate their whole device to simulate the pouring action (instead of simply clicking or swiping). These unique interfaces will incorporate an element of experimentation into the physical interactions with laboratory equipment. This design is essential to capturing the experience of conducting an actual alchemical process.

ENVIRONMENT TRANSLATION

David Teniers the Younger, 'Alchemist in his Workplace', ca. 1650

Translated environment render

The comparison above illustrates how the composition of the source material could translate into an interactive 3D environment for players to explore.

GAME DESIGN DYNAMICS

GAME DYNAMICS

In video game design, dynamics are the ways in which players interact with a game's mechanics. Where the mechanics, or rules, of chess dictate how a knight can move across the board, the dynamics of chess encompass the strategies players employ while moving the knight. *Age of Alchemy* employs three core dynamics for players to interact with the game world:

EXPLORATION

Players are invited to step into detailed alchemical laboratories and explore the workspace, poking around the virual environment in search of useful tools and ingredients they can use to conduct experiments. This mechanic mirrors alchemical practitioners' exploration of the natural world's material properties.

INTERPRETATION

At the heart of alchemy lies a vast collection of manuscripts outlining various metallurgic and medicinal scientific experiments. Howeve , many of these documents were encoded in allegorical writing and imagery to protect trade secrets. Players are tasked with decrypting these documents to understand the steps of each experiment, much as an alchemical practitioner would have needed to interpret and master key texts.

### EXPERIMENTATION

Success in alchemy depended in part on skillful manipulation of available tools and process. Once players have revealed the experimental process and collected the required equipment and ingredients, they can begin combining elements and creating chemical reactions. How well players have interpreted the lab manuscripts will determine whether their experiment succeeds or fails.

LEVEL WALKTHROUGH
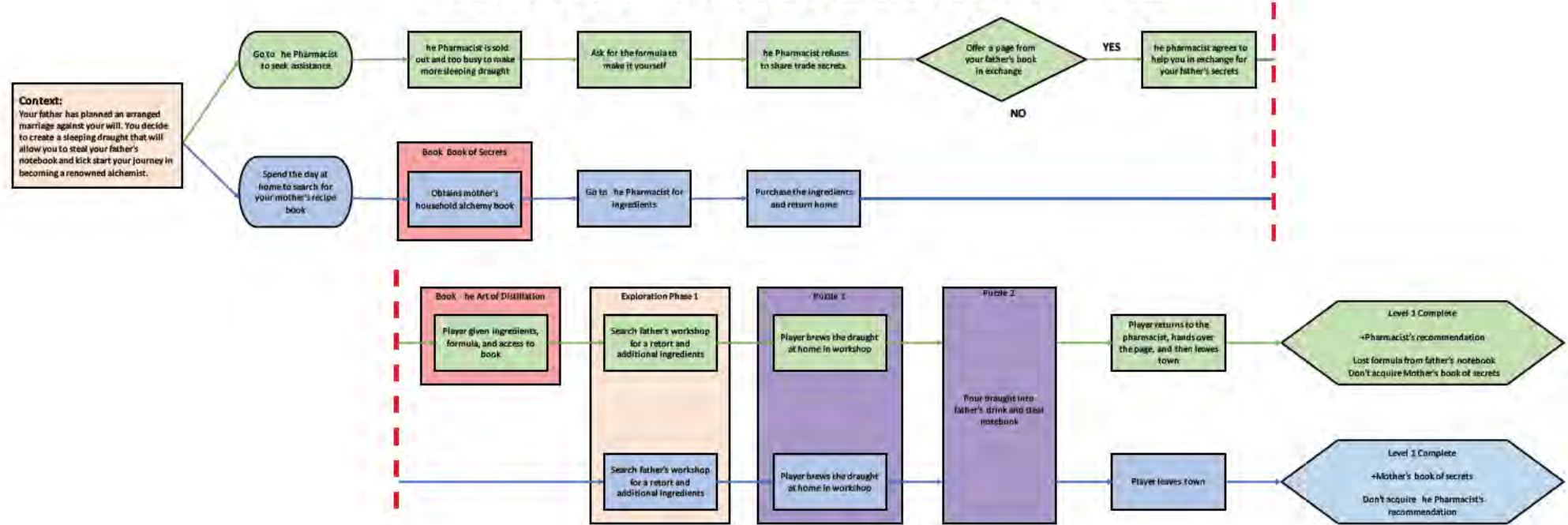
LEVEL 1 WALKTHROUGH

The following is a granular walkthrough of the proposed first level of *Age of Alchemy*. Each frame represents the ideal next step to progress through the level as quickly as possible. While the specific content of this sequence is subject to change, the storyboard is representative of how exploration, interpretation, experimentation, and narrative are intertwined to form an engaging gameplay experience.

NARRATIVE CONTEXT

At the beginning of the game, our protagonist Viola is preparing to run away from home after her father has moved forward in planning an arranged marriage against her will. Viola realizes it is time to leave home and pursue her interests in alchemy. She decides to create a sleeping draught that she can administer in her father's dinner. With her father safely asleep, Viola will be free to steal her father's notebook of metallurgy research and begin her journey to become a renowned alchemist.

NARRATIVE BRANCHES

The level opens with a narrative branch that will alter the player's progression through the scene. In this illustration, the green branch will be noted as "Branch A" and the blue as "Branch B." Any unmarked content is shared between both branches.

STORYBOARD FRAME 1

At the beginning of the level, Viola must acquire a sleeping draught recipe. The player must decide to search the house first, or go straight to the pharmacist

DECISION 1 - BRANCH A

STORYBOARD FRAME 2A-1

The Pharmacist

" *Sorry, I just sold my last bottle. The next batch should be ready in a few days. But I might be willing to share my recipe for a few secrets from your father's notebook . . .* "

If the player opts to go straight to the apothecary, they learn he is out of sleeping draught but is willing to sell the recipe and ingredients in exchange for a page from Viola's father's notebook. If the player agrees, they proceed to frame 2A-2. Otherwise, they proceed to 2B-1.

STORYBOARD FRAME 2A-2

The Pharmacist

" *Alright, make sure you return here tonight with that notebook. Now let me find that recipe . . .* "

Viola agrees and players receive the sleeping draught recipe and ingredients.

Figure of Apothecary adapted from Italian School, "*Alchemist Filling Wet Drug Jars,*" 17th century, CHF collections.

DECISION 1 - BRANCH B

STORYBOARD FRAME 2B-1

Viola

Ah! Perfect! Knew she had it somewhere around here.
Looks like I'll need to go the pharmacy for some of these ingredients.

Viola searches the house and finds her mothe 's notebook containing a recipe for sleeping draught. The player determines that there are a few ingredients required for the draught that cannot be found in the house.

STORYBOARD FRAME 2B-2

The Pharmacist

" *Saltpeter and poppy seeds? We should have some in stock.* "
Let me see what we have here . . .

Viola goes to the apothecary and buys the ingredients to make the sleeping draught.

STORYBOARD FRAME 3

Viola returns home to the kitchen and must consult the recipe to make sure she has all the ingredients.

STORYBOARD FRAME 4

Player is tasked with translating the source material (left) into a more straightforward analysis in Viola's journal (right).

STORYBOARD FRAME 5

Player drags and drops pieces of information from the source text into Viola's journal where the information is translated into modern English.

STORYBOARD FRAME 6

With the simplified list of ingredients and sleeping draught recipe, Viola needs to find the remaining ingredients around the house.

STORYBOARD FRAME 7

Player taps on the head of lettuce to add it to their inventory.

STORYBOARD FRAME 8

Player taps on the bookshelf for a closer look at its content.

STORYBOARD FRAME 9

Player taps on the jar of sugar to add it to their inventory.

STORYBOARD FRAME 10

Player moves from the kitchen room into the workshop.

STORYBOARD FRAME 11

Player taps on the bookshelf for a closer look at its content.

STORYBOARD FRAME 12

Player must now translate instructions for assembling a distillation apparatus.

STORYBOARD FRAME 13

Player drags and drops pieces of information from the diagram into Viola's journal, creating a simplified set of instructions

STORYBOARD FRAME 14

With the knowledge of distillation, Viola needs to collect a retort to begin the experiment.

STORYBOARD FRAME 15

Player taps on the retort to add it to their inventory.

STORYBOARD FRAME 16

Player moves back into the kitchen.

STORYBOARD FRAME 17

Player taps on the kitchen stove and places the retort. This will allow them to begin the experimentation process.

STORYBOARD FRAME 18

Player drags the poppy seed into the mortar.

STORYBOARD FRAME 19

Player is prompted to swipe left and right to grind the poppy seeds and add water.

STORYBOARD FRAME 20

Player pours the poppy seed mixture into the bowl and is prompted to strike a fire by quickly swiping across the screen.

STORYBOARD FRAME 21

Player adds sugar to the mixture to create a poppy seed syrup.

STORYBOARD FRAME 22

Player drags lettuce into the mortar.

STORYBOARD FRAME 23

Player grinds the lettuce and adds water.

STORYBOARD FRAME 24

Player pours the poppyseed syrup into the retort.

STORYBOARD FRAME 25

Player pours the lettuce water into the bowl.

STORYBOARD FRAME 26

Player adds saltpeter to the lettuce water.

STORYBOARD FRAME 27

Player adds the lettuce water to the poppy seed syrup and strikes a fire under the retort. Player waits for the sleeping draught to be distilled.

STORYBOARD FRAME 28

Player has successfully created a sleeping draught.

STORYBOARD FRAME 29

Viola enters her father's room. The player must decide how she presents the draught.

STORYBOARD FRAME 30

Viola's father happily accepts the sleeping draught.

STORYBOARD FRAME 31

Viola waits for her father to drink the sleeping draught.

Figure adapted from Justus Juncker, "*The Village Chemist,*" CHF collections.

INTERPRETIVE TEXTS

PRIMARY SOURCE DOCUMENTS

The game is designed to prominently feature the collection of paintings and manuscripts housed at the Chemical Heritage Foundation. By designing the project's gameplay around source texts, players are encouraged to engage with the material through novel interactions. Detailed below are the three core methods the game incorporates these sources directly into the playing experience.

PAINTINGS

In each level players are invited to explore rooms that serve as 3D recreations of the environments depicted in the source paintings. This provides a unique feeling of "stepping into" each painting and seeing the work from a different perspective.

MANUSCRIPTS

The game also lets players interact directly with the interpretive texts by incorporating alchemical manuscripts into the game's puzzle design.

PERIOD MUSIC

The game incorporates recordings of period music compositions that accompanied alchemical texts. Exposing players to music in the game will enhance the experiene and will help players understand that alchemy was a cross-disciplinary pursuit that could combine music, poetry, art, and experimental theory.

3. TECHNICAL SPECIFICATIONS

UNITY 3D GAME ENGINE

The game will be built in the Unity3D game engine and developed for iOS and Android phones and tablets and optimized for devices released after 2014. As one of the most accessible commercial game engines, Unity3D is well supported by all major gaming hardware manufacturers. This allows games made with Unity3D to be easily updated for compatibility with new operating system versions and platform features. It also decreases the resources needed from cross-platform development since the engine has been designed to easily compile projects across each of the most popular gaming devices.

ENGINE BENEFITS

As a result of the high adoption rate among professional developers, a vast collection of troubleshooting resources and development tools have been generated that allow the Unity3D engine to be customized and extended to optimize the production workflow on an individual project basis. This will allow the Gossamer team to customize the editor interface and create valuable debugging tools tailored to the specific needs of the *Age of Alchemy* game.

USER GENERATED CONTENT

Due to the target platforms and overall design of the project, we do not anticipate any user-generated content.

4. SUSTAINABILITY PLAN

MAINTAINING *AGE OF ALCHEMY*

As noted in the Technical Specifications section, our game will be built using the Unity3D game engine. This software tool is already an industry standard tool that has both robust documentation, support, and frequent version updates. We intend to update the game to the most current software versions throughout the lifecycle of this project, avoiding any potential security issues or bugs. Patches to the game will be published through the application stores for both iOS and Android.

By using Unity and third-party Unity plugins, rather than creating our own game engine or plugins, the Gossamer team is able to leverage the latest in game development technology to save both on development time and costs. Unity3D allows us to create modular elements that can be repurposed for use throughout the game, and gives us the ability to add additional narrative modules with relative ease.

MonoDevelop, Unity's proprietary scripting program, allows us to create and reuse custom scripts throughout our game. The Unity software emphasizes the extensibility of elements of code and game assets, more opportunities to utilize the mechanics and assets developed for this game in additional narrative modes and, possibly to extend the game to include information about other regions and time periods in subsequent modules, for instance the early modern Atlantic World or Asia, with the collaboration of other institutions with significant holdings in these areas.

We hope to use the prototype developed in this phase of this project to pursue additional funding sources to build a commercially releasable version of the game. We believe that it will take an additional 12-18 months of development to bring about a version of the game that is ready for a commercial release.

This final version of the game would be made available through Android application marketplaces, Google Play, and the Apple App Store.

Once the final version of the game is released, we anticipate moderate upkeep costs ($2,000 - $5,000 annually) associated with updating the software to run on the latest mobile devices, while still maintaining a reasonable degree of backwards-compatibility. Developing a plan to fund these maintenance costs will be part of future production work.

Age of Alchemy - Gossamer Budget

Age of Alchemy Prototype Development Costs

Prototype Development Costs	
Item	Design Costs
Director / Programmer	$15,000.00
Lead 3D Artist	$15,000.00
3D / 2D Artist	$15,000.00
Prototype Production Costs	
Office Expenses	$12,000.00
Software Licenses	$7,000.00
Hardware Costs	$4,000.00
Legal Fees	$2,000.00
Total	$70,000.00

Prototype Development Costs

- Director / Programmer: $15,000
- Lead 3D Artist: $15,000
- 3D / 2D Artist: $15,000

Prototype Production Costs

- Office Expenses: $12,000
- Software Licenses: $7,000
- Hardware Costs: $4,000
- Legal Fees: $2,000