Narrative Section of a Successful Application

The attached document contains the grant narrative of a previously funded grant application. It is not intended to serve as a model, but to give you a sense of how a successful application may be crafted. Every successful application is different, and each applicant is urged to prepare a proposal that reflects its unique project and aspirations. Prospective applicants should consult the Public Programs application guidelines at http://www.neh.gov/grants/public/digital-projects-the-public for instructions. Applicants are also strongly encouraged to consult with the NEH Division of Public Programs staff well before a grant deadline.

Note: The attachment only contains the grant narrative, not the entire funded application. In addition, certain portions may have been redacted to protect the privacy interests of an individual and/or to protect confidential commercial and financial information and/or to protect copyrighted materials.

Project Title: Pox and The City

Institution: Richard Stockton College

Project Director: Lisa Rosner

Grant Program: Digital Projects for the Public, Prototyping

2. Application Narrative

Project Title: *Pox in the City: A 3D Strategy Game for the History of Medicine*
Institution: Stockton College
Project Director: Dr. Lisa Rosner, Distinguished Professor of History
Grant Program: Digital Projects for the Public: Prototyping Grants

A. Nature of the request

Stockton College is requesting $99,837.00 to develop a working prototype that demonstrates the humanities ideas, digital technology, and public outreach for a Unity 3D strategy game entitled *Pox in the City*. This game, developed in partnership with award-winning game design studio Eduweb (http://www.eduweb.com), draws upon a core interpretive framework for historians: that medical beliefs, practices, and treatment are shaped by the interaction of the healer, the patient, and the disease entity. As the game begins, players step into the shoes of a young physician who has arrived in Philadelphia in 1802, just as a smallpox outbreak erupts. Armed only with Edward Jenner's new vaccination technique and a will to succeed personally and professionally, players undertake the grand challenge of using this new medical tool to stop the spread of the disease by persuading patients to be vaccinated. The interactive format will immerse players in the city's rich history as a political, intellectual, and commercial center, as they experience the choices made by historical actors and constrained by scientific knowledge and cultural values.

Although there are existing games that include contagion as a trigger to drive game play, *Pox in the City* is innovative in merging a rich humanities narrative with interactive game design. It explicitly examines the historical and social contexts for the scientific development and dissemination of vaccines. It also responds to NEH's Bridging Cultures initiative, by showing how Philadelphians with diverse economic, racial, and ethnic backgrounds and perspectives responded to the new vaccine. The game is being developed and showcased in partnership with the Mütter Museum of the College of Physicians of Philadelphia (http://muttermuseum.org), a leading cultural heritage institution with an outstanding record of public programming. The game can be played solo, with one person against the virus, or with 2-4 players playing either cooperatively or competitively. It will be designed as a web-based game with the potential to be released as a native app for iOS and Android tablets.

B. Humanities content

When a medical scientist makes a new discovery, what happens next? It is rare that the new idea carries all before it because it is obviously superior to previous practice. Instead, historians of medicine speak of a three-way interaction in the diffusion of new ideas. First, the idea must win acceptance among medial practitioners. Then, patients must choose to go to those practitioners in order to benefit from the new technique. Finally, the disease will take on a new identity depending on the effectiveness of the treatment and how well it adapts.

The humanities content and game structure of *Pox in the City* provides an ideal medium for demonstrating how game interaction can promote historical interpretation. The onset of the smallpox outbreak provides the trigger for gameplay, as it historically has triggered social and medical efforts to contain disease. Players must respond to the outbreak by convincing patients to be vaccinated, as their historical counterparts would have done. In order to win the game, they must understand the social geography of the city, thus modeling the historical process of public health initiatives. And the wealth of available historical material allows the game to present a detailed interpretation of the impact of Jenner's cowpox vaccine among disparate communities in early 19th century Philadelphia.

We have identified five major humanities themes to present in *Pox in the City*: the cultural history of scientific innovation, the social context of medical practice, the perspective of the patient, the development of science education for women, and the human history of epidemic diseases.

B1. Cultural History of Scientific Innovation

The introduction and spread of vaccination for smallpox is ideal for showing how social, economic, and cultural factors shaped the acceptance of scientific innovation. In 1798, Edward Jenner (1749-1823) published *An Inquiry into the Causes and Effects of the Variolae Vaccinae, a Disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of the Cow-Pox.* This was the first printed announcement of a process that became known as "vaccination", in which patients were infected with matter from the mild disease cow-pox, so that they would develop immunity to the much more virulent disease of smallpox. Later, popular accounts depicted this as a new "discovery" made by a dedicated, self-taught country practitioner, and that fits well with the modern myth of scientific innovation as a heroic endeavor by an isolated, often embattled individual (Gross, Sepkowitz, 55).

Jenner never thought of either himself or his discovery that way. By the time of his research on cowpox, he was a well-established scientist, who, like many of his colleagues in Britain's prestigious Royal Society, was keenly interested in social and scientific techniques for protecting the population of Great Britain from smallpox. The basic method of inoculation, in which children were infected with a mild form of the live smallpox virus to provoke their immune response, had been introduced to the English-speaking world in the early 18th century, through the efforts of Lady Mary Wortley Montague. By the 1760s, inoculation was a standard practice in well-to-do households, particularly in medical families: Jenner himself was inoculated as a child. The procedure was well established, as recorded in Professor John Gregory's notes to his students. It began with a child with a mild case of smallpox. Then, Gregory told his students, "In order, to Inoculate, hold the Lancet, with the flat side upwards, between your forefinger and thumb, [and] just moisten the tip in the [smallpox] matter." The next step was to "make two small punctures in the arm, about two inches apart, wipe the lancet on the punctures, and it is

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done; if the blood starts the puncture is deep enough." (Gregory) For the most part, this worked very well to reduce mortality from smallpox among those who were inoculated.

But while this might protect individual patients, it was far from perfect. For one thing, the children, while infected, were contagious. For that reason, practitioners always inoculated all the children in a family at the same time, and the children were usually sent away from the household until they had made a full recovery. That meant that inoculation was really only an option for well-to-do households: the poor lived in such crowded conditions that inoculating one child, or one family, could easily spread smallpox to the entire village or tenement. In the second half of the 18th century, physicians and community leaders tried exhorting "the poor" to inoculate their children, assuring them the procedure was much safer than catching smallpox "the natural way," that is, during an outbreak. They found some success when inoculation was offered for free, either by the practitioner himself or – more usually – through medical institutions like public hospitals or dispensaries. The demand for inoculation went up dramatically whenever there was an outbreak. Yet even then, practitioners complained, "the poor" neglected to get their free medical care. Or, having inoculated their children, they would not isolate them. Instead, recently-inoculated children, still infectious, would sleep in the same room and the same bed as untreated children, and go back out to work as soon as their strength returned.

We can better understand Jenner's true innovation if we think of inoculation as a form of technology. It was successful at doing what it was designed to do – protect a specialized population from smallpox – but it was difficult, and costly, to scale up to a broader audience. As an established medical practitioner in rural Gloucestershire, Jenner was thoroughly familiar both with the technology and its limitations. Historians of technology Thomas Hughes and Brian Arthur have argued that these are the preconditions for technological innovation, and we can use them as a lens to re-examine Jenner's 1798 *Inquiry*.

By the 1790s, when Jenner began his investigation, he probably had already heard of the folk-belief that farm workers who had contracted cowpox could not be infected with smallpox. Cowpox was not, at that time, acknowledged as a subject for medical or scientific inquiry. It did not even have a scholarly Latin name until Jenner dignified it with the appellation *Variolae vaccinae* (literally, pox of cows) in his *Inquiry*. His innovation – and his brilliance -- consisted in his recognizing that if the folk belief was true, he could use it to improve the existing inoculation technology. Cowpox was never fatal, and it was much less infectious: indeed, it could only be spread by direct, physical contact. If it could be introduced in the same way as the smallpox virus – those two punctures with the lancet – physicians could simply substitute the new "matter" for the old; doing so would completely eliminate the need for costly, ineffective public health measures like quarantine. To use the modern phrase, he really would have built a better mousetrap.

Jenner's first step was to document that the folk belief could stand up to scientific investigation, and he did so in the first sixteen cases of the *Inquiry*. Modern popular accounts of Jenner tend to skip over those sixteen cases, because it is only in the seventeenth that he gets to what we regard as an actual experiment, the inoculation of a healthy child with cowpox matter before inoculating him with smallpox. But those first cases are essential: they introduce his scientific audience to the disease of cowpox, the material he proposed to use to protect their patients.

By the time contemporary readers got to the seventeenth case, in which Jenner inoculated James Phipps, a healthy eight-year-old child, with cowpox matter from the dairymaid Sarah Phipps, they would have followed his reasoning and agreed with his findings. Dairymaids

typically developed cowpox on their hands, that is, the part of their body that came in direct contact with the teats of cows. Jenner, though, inoculated Phipps with cowpox on the arm, as if he were following the standard procedure for smallpox. He was delighted to see that the postules appeared in the same way as if he had used smallpox matter: as he put it in the measured language of the 18th century, "This appearance was in great measure new to me, and I shall ever recollect the pleasing sensations it excited; as, from its similarity to the postule produced by variolous [smallpox] inoculation, it incontestably pointed out the similarity between the two diseases." (Jenner, *Inquiry*, 31)

What this meant is that Jenner's new mousetrap had worked, and his future experiments, and those of his contemporaries, supported that conclusion. Though he certainly faced some opposition, he was also acclaimed a great benefactor of his country and received awards from Parliament to continue his research and educate the public about his practices. Vaccination, as inoculation with cowpox matter came to be called, spread rapidly throughout Great Britain, the European continent, and the United States. By 1807, Jenner noted in wonder, he was receiving thousands of letters from "all, or nearly all, of the civilized nations of the Earth. Who would have thought the Chinese would have adopted it? But so it is" (Jenner, Letter).

And yet, though the practice of vaccination spread all over the globe, no amount of letter writing from Jenner, or from his scientific and medical counterparts, was enough to convince patients to adopt it. That had to be done on a case by case basis, by medical practitioners in town and country. What reasons did they have to adopt this new technique?

B2. The Social Context of Medical Practice

In order to explore why doctors adopted Jenner's new method, we can look at the Philadelphia medical marketplace, which is very well-documented for the colonial and early national periods. Philadelphia, as described by Robert Morris's frequently-quoted letter to John Hancock, "from its centrical situation, the extent of its commerce, the number of its artificers, manufactures and other circumstances," was "to be to the United States what the heart is to the human body in circulating the blood" (cited in Otter, 113-4). This anatomical comparison is apt from the perspective of medical practice as well as commerce, for Philadelphia was a major center of medical education in the early Republic. Medical students circulated, like blood in the arteries, from southern and mid-Atlantic colonies into the city for medical apprenticeships and formal education at the University of Pennsylvania. Recent graduates from the medical schools of Columbia College in New York and Harvard College in Boston also came to the city, hoping to settle into thriving practices or find positions in merchant ships. The easy accessibility of medical classes for anyone who could afford to pay the professor his fee, and the growth of medical institutions, ensured the continuous production of medical professionals.

The result was an intense competition among young medical men, who looked for ways to distinguish themselves from their professional rivals. The Pennsylvania Hospital, for example, was firmly allied with the University of Pennsylvania medical school, an arrangement which gave the medical professors a distinct advantage in attracting students, since they could provide hands-on clinical training. In response, young physicians eager to establish themselves provided medical lectures at the Philadelphia Almshouse, including clinical lectures in the Almshouse wards. They were so successful that foreign visitors included the Almshouse in their reports on American medical education and practice (Hunter, 51-53).

The Almshouse physicians seem to have incorporated inoculation into their treatment from at least the 1770s: a report from the minutes states that this "Charitable Service hath often

been performed, and always with success, and at this time 20 Poor Children are all happily coming through the Disease under Inoculation and several in the Natural Way."(Hunter, 44-6) According to historian Sara Gronim, smallpox inoculation provided other kinds of commercial opportunities as well. Some physicians, surgeons, and apothecaries developed inoculation techniques as medical specialties. This might include offering lodging to the young patients, so that they could recover without infecting their own households or neighbors. One Connecticut doctor advertised an "inoculation hospital," claiming to have successfully treated upwards of 1000 patients from inoculation through complete recovery, for 4 pounds each (Gronim, 267). If this were true, it would have generated an enormous income from medical practice.

Jenner's vaccination methods provided new opportunities both for professional advancement and professional rivalries. Benjamin Waterhouse, Professor of Medicine at Harvard College, corresponded with Jenner and was the first American physician to obtain some of the cowpox lymph. He set up a "Kine-Pox Institution" to provide vaccination, sending some of the lymph to Thomas Jefferson. He had previously been embroiled in a number of quarrels with his colleagues, and his Kine-Pox Institution provoked another, when Waterhouse was accused of setting up a monopoly for his own personal gain (Waterhouse). In Philadelphia, John Redman Coxe published *Practical Observations on Vaccination Or Inoculation for the Cow-pock* in 1802; he also promoted the practice in his journal *Philadelphia Medical Museum* and in his drugstore, where he sold his popular home remedy Coxe's Hive Syrup (Coxe, "John Redman Coxe"). The records of Dr. Daniel Swinney, whose archives are preserved in the College of Physicians of Philadelphia's library, illustrates a successful vaccination practice.

Coxe, like Waterhouse, made a point of informing his readers of his correspondence with President Jefferson, from whom he received an "infected thread" containing the cowpox matter. And he made a point of investigating, and exposing, any case history that seemed to cast doubt on the vaccine's efficacy: "Such are the falsehoods," he wrote, "which impede the progress of the brightest discovery that has ever been made!"(Coxe, *Practical Observations*, 125). It was a truth that Coxe and his fellow proponents held to be self-evident: that all right-minded people must accept the value of the cowpox vaccine.

But why did physicians have to work so hard to promote this self-evident truth? Why didn't patients just do as the doctors ordered?

B3. The Perspective of the Patient

In 1985, Roy Porter's seminal article "The Patient's View: Doing Medical History from Below," pointed out that "a physician-centered view of the rise of medicine may involved a major historical distortion. For it takes two to make a medical encounter…Indeed, it often takes many more than two, because medical events have frequently been complex social rituals involving family and community as well as sufferers and physicians. Moreover, a great deal of healing …has involved professional practitioners only marginally, or not at all, and has been primarily a tale of medical self-help, or community care." It is the patient, or his/her family, who initiated the medical encounter by taking on the sick role and deciding to seek treatment; for that reason "power has frequently rested with the sufferer…rather than the individual physician or the medical profession at large" (Porter, 175).

When we look at Philadelphia medical practice through the eyes of the patient, we can see how that power worked. On every street in the city – often, right next door to an MD -- residents could find a wide assortment of healers, listed as "cuppers," "bleeders," "dentists", "surgeon-barbers," and "apothecaries". Other, less common designations were "bone-setters"

and "doctresses". Contemporary recipe books and diaries show that patients might choose to call any of these practitioners, rather than a physician. Margaret Burd wrote down a prescription for "fever and ague" she got from an apothecary on Market Street; Sally Downing applied to a woman "who is noted for reducing dislocated bones by greasing and gentle pulling." One of Elizabeth Drinker's friends "was so unwell" one morning, "with a giddy head &c, that she sent for the bleeder," without consulting a physician. General Anthony Wayne included the instructions "to be *bled* plentifully" in his home remedy for pleurisy (Rosner, 31-34).

It's not that these well-off men and women did not trust their physicians. Rather, they thought of medical treatment in the same way as many modern patients: for each ailment, they performed a rough cost-benefit analysis to determine whether the discomfort or seriousness of their disorder warranted the expenditure in time and money for an elite physician. We can compare this to our own health-care decision-making: we first notice that we have a headache, wait for it to go away, then take a pain-killer and wait some more. Only if the headache persists for a longer period than we are comfortable with – which may depend on how old we are, and what our previous health encounters have taught us – will we take time off work to go to a doctor. It seems likely that Drinker's friend followed a similar thought-process: she felt giddy and unwell, and probably waited for the feeling to go away; when it did not, she called the bleeder. Only if her illness persisted would she spend the time and money to call a physician.

If that were true of wealthy patients, how much more significant was this cost-benefit analysis to poorer or socially marginalized families? Elite physicians –those with an MD from a medical school -- made up less than a third of the medical practitioners listed in Philadelphia city directories. Their residences were clustered in the wealthy areas of the city, along Washington Square, Arch and Spruce streets. There must have been many artisan households in Appletree Alley and environs, or African American families in the Dock Street district, who would never have encountered an MD at all. No matter how "giddy and unwell" they felt, they would not have been able to pay the fee that elite physicians charged for a visit.

Does that mean that such patients would never hear about Edward Jenner and his "bright discovery"? Not necessarily: from the early 1800s, clergymen and civic leaders urged every household to vaccinate their children and provided free access through public medical institutions. In Philadelphia's Free Black communities, the periodical press promoted the cause of vaccination: "Is it not remarkable," asked the editors of *The Liberator*, "that this scourge of the human race be suffered to gain a foothold among us, when it is so easy a matter to keep it at a distance?" The *African Observer* compared "this scourge" of smallpox to the "dire disease" of slavery, urging its readers to take steps to prevent the spread of both (Delancey, 307-310).

Still, the fact that vaccination could only be obtained through elite physicians clearly impeded its progress. As public health officials everywhere learned over the course of the next century, if they wished to encourage widespread vaccination, they had to put it in the hands of people who regularly came into contact with small children. In Sweden, local and national health authorities allowed clergymen and church assistants to carry out vaccination from 1803; by the middle of the 19th century, midwives could be certified as vaccinators as well (Skold, 258). Had Philadelphia clergymen and midwives been given the same authority – and the same access to cowpox matter – vaccination might have spread more rapidly through the city.

There was, however, a very visible group of Philadelphians whose day-to-day authority over very young children was seldom contested: their mothers. What would possibly make a mother wish to vaccinate her child?

Fathers in 19th century Philadelphia, as elsewhere, were the heads of the household, wielding both legal and moral authority over their children. Medical writers on vaccination often record "gaining the assent" of a father in order to vaccinate "his" family. But since the optimum age for vaccination was from 6 months to 6 years, it was generally the work of the mother, or the servants she supervised, to bring "her" children into the room with the doctor, to hold them during the procedure, and to care for them during recovery. If children were being vaccinated at the Pennsylvania Hospital, their mothers had still more work to do, and more influence over the successful outcome of the procedure.

It was social reformers, rather than physicians, who drew an obvious moral from this: mothers must be educated in science and medicine, in order to protect the health and well-being of their children. Emma Willard, influential founder of the Troy Female Seminary, argued that mothers were responsible for their young children's physical and moral character. "How important a power is given by this charge!" she wrote. "Yet, little do too many of my sex know how, either to appreciate it or improve it. Unprovided with the means of acquiring that knowledge, which flows liberally to the other sex-having our times of education devoted to frivolous acquirements, how should we understand the nature of the mind so as to be aware of the importance of those early impressions, which we make upon the minds of our children? --or how should we be able to form enlarged and correct views, either of the character, to which we ought to mold them, or of the means most proper to form them aright?" (Willard; Scott, 6).

The answer was the female seminary movement, where young women could gain the types of instruction that would form their character. Over the first quarter of the 19th century, female seminaries added Astronomy, Chemistry, Natural Philosophy, and Botany to their curricula (Tolley, 38). At the Young Ladies Academy in Philadelphia, the prominent physician and medical professor Benjamin Rush taught the first formal course of chemistry for women in the United States. These topics were broader than their modern counterparts: Astronomy often included physical and political geography, and Chemistry included the physiology of respiration and circulation of the blood. Science had become a branch of general knowledge, necessary for girls because it was necessary to build an educated American citizenry.

This formal science education for girls was supplemented by books and exhibitions, what a later generation called "popular science" – popular, both because it was attractive and exciting, and because it was intended to put scientific knowledge at the disposal of a broad range of people. Jane Marcet's *Conversations* series, first published by Longmans in London, was the undisputed leader in informal science education, beginning with *Conversations on Natural Philosophy* in 1805 and following up with *Conversations on Chemistry* in 1806, and *Conversations on Plant Physiology* in 1821.

These books imparted not only new knowledge, but also a sense of wonder at all the new scientific discoveries and inventions that defined the age, wonder that extended to the new vaccine. Philadelphia printer James Humphreys published American editions of both Jenner's *Inquiry* and of Marcet's *Conversations on Chemistry*. Philadelphia novelist Charles Brockden Brown included articles on Jenner in *The American Review and Literary Journal*. Charles Peale's Museum explicitly cultivated an audience, as he wrote, "of every sex and age." Its purpose was to "diffuse a knowledge of the wonderful works of creation, not only of this country, but of the whole world…to form a school of useful knowledge, to diffuse its usefulness to every class in our country, to amuse and in the same moment to …"(Sellers, 18). His self-portrait, "The Artist in His Museum," depicts Peale as the impresario he was: as he draws back

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the curtain, we see a lady and two gentleman, one with a small boy, in rapt attention to the many "wonderful works of creation" on view.

But danger as well as enlightenment lurked in large urban centers. The audience that shared a lecture-hall shared their microbes, and cities had, throughout human history, promoted epidemics as well as commerce. We have already looked at Philadelphia from the doctor's and patient's point of view. What might a smallpox virus have made of it?

B5. Human history of epidemic diseases

Recent scholarship has transformed our understanding of disease entities, so that we now view epidemics as part of human history. Elizabeth Fenn's *Pox Americana: The Great Smallpox Epidemic of 1775-1782*, uses smallpox as a mechanism for revealing historically devastating, yet previously unexamined, effects of the War of Independence. Michael Willrich's *Pox: An American History*, uses an early 20th century smallpox outbreak to explore ongoing American debates about public health and civil liberties. These books, like William McNeil's *Plagues and Peoples*, have expanded historians' definition of the human environment to include pathogens as well as plantations, immune systems as well as institutions.

The most common form of smallpox has the Latin name *Variola major*, and it has existed in tandem with human societies long enough to have developed distinct strains. Ordinary smallpox affects about 90% of patients, who develop the classic smallpox symptoms, high fever and the terrible rash that gives the disease its name. It has a fatality rate of 30%. Mild or moderate smallpox, as the name implies, is less common and much less dangerous. The two other strains, flat and hemorrhagic, are almost invariably fatal: in both cases the virus overwhelms the patient's immune system and destroys essential organs before the rash has time to develop. *Variola minor*, a mild illness with less than 1% mortality, is considered a distinct clinical entity.

On the microscopic level, smallpox behaves like other viruses, by invading cells in order to reproduce. Many people are infected through inhaling the virus present in the air, or by touching infected pustules, and then touching their nose or mouth. The virus attacks the epithelial cells of the mouth and throat first, using them as incubators to produce millions of its own kind. They then spread throughout the body, attacking other kinds of cells. Once they get to the skin, they can produce hundreds of pustules, each of which becomes its own incubator of infection. If we wish to add to the image of smallpox, we can say that its life-cycle turns the entire human body into a virus-creation-and-distribution factory. The extent of the distribution is limited only by the amount of skin to infect, and sufferers remain contagious until the last scab on the last pustule heals.

 We can't help but find it chilling that the virus can turn our own skin against us. It does the same with our social organization. We are social animals, and when we get smallpox, we often give it to our families. If those families live and work in bustling neighborhoods with crowded markets, smallpox will infect our neighbors. If our neighbors work in dockyards, with ships coming and going throughout the Atlantic world, or in schools or law courts or laundries or taverns, then, again, smallpox will spread. Fenn's *Pox Americana* clearly documents the way in which the social networks of 18th century America, from settlement patterns to trade routes to army movements in the War of Independence, became the distribution networks that spread *Variola major* across the continent, with devastating effect.

Smallpox had long been endemic in18th century Philadelphia, showing up routinely on 18th century bills of mortality (Klepp). Still, Philadelphians had some protection from both

biology and society. The human immune system protects the body against *Variola major* by marshaling T and B cells; if they are successful, they create memory cells that protect the body in case of later attacks by the virus (http://www.historyofvaccines.org/content/how-vaccines-work). Those recovered patients are immune to the disease, and the more people who are immune, the harder for the disease to spread. Moreover smallpox has two additional characteristics that make quarantines comparatively effective: the symptoms are very visible during the contagious period, and the virus requires a comparatively long period of contact in order to spread from person to person. Yellow Fever, which claimed so many lives in 1793, was not so considerate.

Inoculation with the smallpox virus put a roadblock in its path. It provoked the same T and B cell response, and so conveyed immunity, but it was safer for the individual inoculated, because it was carried out with a milder strain of the disease. But it only broke a single link in the chain of transmission, which *Variola major* was designed to circumvent: since the patient still carried the live virus until completely recovered, he/she was still an efficient transportation service. It is likely that inoculated Philadelphians contributed to the spread of the disease throughout the early years of the War of Independence (Fenn, 82-86).

Inoculation with cowpox virus, though, was – literally -- a different matter entirely. Once vaccinated, people were simply inaccessible to the smallpox virus: they could not catch or transmit the once-deadly disease. The entire chain of transmission was broken, because the virus had lost its only host. Jenner's vaccination was a true historical milestone for *Variola major* as well as for the human society it inhabited.

This narrative has described five aspects of the three-way interaction between healer, patient, and disease entity: the cultural history of scientific innovation, the social context of medical practice, the perspective of the patient, the development of science education for women, and the human history of epidemic diseases.These humanities themes provide rich, multi-faceted approaches to authoritative and engaging gameplay.

C. Project format

This project is set up to design, produce, playtest, and assess *Pox and the City*, a 3D game in which players take on the role of a physician trying to stop a smallpox outbreak threatening Philadelphia. A detailed description of the game will be provided in the accompanying design document.

Key project features include:
- Extensive collaboration between the humanities advisory board and the Eduweb design team. Collaboration will take place through an initial face-to-face meeting with the advisory board, and will be maintained through emails and conference calls facilitated by the project manager. Eduweb will also set up a project wiki, which will become the home for all design documentation as well as visual designs, scripts, and prototypes.
- Refining the project audience goals. We will draw on the experience of advisory board members Karie Youngdahl, James Edmonson, and Lisa O'Sullivan, as well as Mütter Museum outreach staff, in developing a clear understanding of intended audience and a set of goals appropriate for public outreach in the history of medicine.
- Developing a playable prototype of the first level of *Pox and the City*, with full interactive features
- Playtesting the prototype by Eduweb and by members of the advisory board.

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- Creating a project blog, maintained by historian Dael Norwood, as an ongoing resource for information and outreach on issues related to historical games.
- Working with the Mütter Museum to create a Game Night for the Philadelphia Science Festival. The Game Night will include presentations of humanities themes by advisory board members as well as the opportunity for participants to play *Pox in the City* as individuals or in teams.
- Overall assessment of the value of *Pox in the City* as public programming in the history of medicine.
- Development of funding, production, and outreach plan for implementing the full version of the game.

Justification for timeline:
- Design Phase, 4 months. Tasks to be accomplished include:
  - Refining the central interactivity of the game. Eduweb principal David Schaller will work with the advisory board to fashion the rule-based, meaningful play that lies at the heart of the rich humanities content.
  - Outlining the game scenario and elements. This includes reviewing the content requirements in terms of specific assets (text, media, etc.) and making a plan for the necessary content development.
  - Establishing look and feel, thus ensuring that the visual presentation serves the functional and experiential needs of the project.
  - Detailed design document, which will determine production.
- Production, 8 months
  - During this period, Eduweb will prepare deliverables for review by the advisory board. These include alpha and beta versions of the prototype.
  - At least two rounds of playtesting, one for the alpha and one for the beta versions.
  - The outcome will be a playable prototype of the first level of the game, which can be used for external assessment.
- Playtesting and outreach, 4 months
  - Members of the advisory board will carry out a detailed assessment of the final prototype, based on their areas of expertise.
  - The final prototype will be incorporated into a Game Night at the Mutter Museum during the Philadelphia Science Festival. Outreach staff at the Mutter Museum will be asked to assess the value of the game in public programming.
- Assessment and reporting, 3 months
  - The Principal Investigator will prepare a detailed White Paper analyzing project outcomes.
  - The Project Manager will prepare a detailed plan for next steps of the project, including fundraising, production, and outreach.

Existing Projects

Existing projects that make vaccination part of gameplay include "Illsville: Fight the Disease," available from the History of Vaccines Online Exhibit and Mobile Website (http://historyofvaccines.org) developed for the College of Physicians of Philadelphia. The game design company Tiltfactor has developed "Pox: Save the People," as both a board and iPad game (http://www.tiltfactor.org/pox/). Both are engrossing interactives that illustrate the concepts of

vaccination and herd immunity, but neither incorporates detailed historical or humanities-based content.

D. Audience and distribution

Pox in the City will be available online as a browser-based game. Ultimately, the complete game will be available as a browser-based game and as an iOS and Android tablet app.

We expect to reach our audience through our partnership with the Mütter Museum of the College of Physicians of Philadelphia. As recent panels at the annual meeting for the American Association of the History of Medicine have made clear, there is broad-based lay interest in the medical humanities, and medical history topics have an expanding presence in public programming (Golden et al, O'Sullivan). Blogs, Twitter, Game Nights, Science on Tap (http://scienceontapphilly.com) and even improv comedy (http://newsblog.drexel.edu/2013/09/18/how-a-health-historian-became-a-comedy-headliner/) have all become mechanisms for engaging public audiences in the history of medicine and science in the Philadelphia area.

We will work closely with staff from the Mütter Museum, as well as with advisors from two medical heritage institutions, Dittrick Museum of Case Western Reserve and the New York Academy of Medicine, in developing the humanities content and public outreach components of the project. All three institutions have a strong record of successful public outreach in the medical humanities:

- The College of Physicians, in conjunction with the Mütter Museum, has a distinguished history of innovation in public programming, including History of Vaccines (http://historyofvaccines.org), a Youtube channel (https://www.youtube.com/user/CollegeofPhysicians), and a collaborative project with the Quay Brothers, *Through the Weeping Glass* (http://www.npr.org/2011/09/21/140637437/quays-focus-weeping-glass-on-the-mutter-museum). Ongoing public programs include their Food and Thought series as well as participation in Science on Tap (http://scienceontapphilly.com/), a monthly science café in which experts present on popular science topics.
- The Dittrick Museum has an active schedule of public speakers and online exhibits, including one on the smallpox epidemic of 1902 (http://www.cwru.edu/artsci/dittrick/museum/smallpox/smallpox.html.
- The New York Academy of Medicine also has an active schedule of public programming with a special focus on urban health issues as well as medical history (http://www.nyam.org/events/).

Additional outreach will be provided by the project blog, written by historian and digital humanist Dael Norwood. Rosner, Theibault, and Schaller regularly present their work at professional conferences and public venues.

We have incorporated an outreach event into our project timeline, a Game Night at the Mütter Museum during the Philadelphia Science Festival.

E. Project evaluation

We will assess the project with respect to the key features listed in "Project Format" above. We do not anticipate any licensing costs or fees.

- Eduweb has planned two rounds of playtesting for the prototype in order to assess its success in incorporating humanities content into engaging gameplay. They will test, troubleshoot, and de-bug the prototype during this process.
- Advisory board members will evaluate the completed prototype with respect to their areas of expertise, using a standard questionnaire to determine player response to game mechanics, humanities content, and interactive features. Joseph Amoroso will playtest the prototype with his high school science students, Laura Zucconi will playtest with her college history students, and Janet Golden will playtest with her graduate students in the history of medicine and public history. Golden will also assess the value of the prototype for presenting the history of public health. Elizabeth Fenn and Jessica Roney will assess the accuracy of the material on early American history.
- Karie Youngdahl, James Edmonson and Lisa O'Sullivan will assess the value of the prototype for public programming in the history of medicine.
- Rosner will provide an analysis of playtesting questionnaires as part of the White Paper for the grant. She will also assess the success of the key project features listed in "Project Format", above.

F. Rights and permissions

Text and art assets will be produced for the game and are not expected to require additional permissions. Permission to use materials held by archives, libraries, and museums will be obtained according to the guidelines set by those institutions. We do not anticipate rights and permissions being a significant aspect of the grant budget.

G. Humanities advisers and outreach personnel

Project Management, Content, and Outreach
Principal Investigator: Lisa Rosner, Distinguished Professor of History, Stockton College. Rosner specializes in 18th and early 19th century medicine, especially the connections between Britain and early America. She has presented history of medicine to a wide range of audiences via public lectures, public library events, and radio broadcasts. She was the PI for the successful Office of Digital Humanities start-up grant, Pox and the City. She is responsible for researching and writing humanities content and coordinating feedback from the Advisory Board. She is also responsible for assessment and NEH reporting.
Project Manager: John Theibault, Stockton College. Theibault is a specialist in digital humanities and has been involved in project management and education outreach at Digital Learning Interactive and the Chemical Heritage Foundation. He is responsible for coordinating project management among advisory board members and the media team. He is also responsible for project outreach and planning for the next phase of the project.
Project Blogger: Dael Norwood, Department of History, Yale University, historian of early America.

Humanities Advisory Board
Joseph Amoroso, Brick Township High School, successfully led high school playtesting for Pox and the City. He is responsible for reviewing all grant materials for the appropriate level of humanities content for high school audiences.

James Edmonson is the Director of the Dittrick Museum, Case Western Reserve University. He is responsible for reviewing all grant materials and assessing the game's value for public programming in the history of medicine.

Elizabeth Fenn, Walter and Lucienne Driskill Chair of Western American History, University of Colorado, is the author of *Pox Americana*: *Pox Americana: The Great Smallpox Epidemic of 1775-1782*. She is responsible for reviewing grant materials for presentation of Native American and African American history.

Janet Golden, Professor of History, Rutgers University Camden, is a historian of public health who also blogs for the Philadelphia Inquirer's online blog at http://www.philly.com/philly/blogs/public_health/ . She is responsible for playtesting with graduate students in the history of medicine and public history, as well as assessing game materials for the public presentation of the history of public health.

Lisa O'Sullivan is Director of the Center for the History of Medicine and Public Health at the New York Academy of Medicine. She is responsible for reviewing all grant materials and assessing the game's value for public programming in the history of medicine.

Jessica Roney, Assistant Professor, Temple University, is a historian of colonial Philadelphia who specializes in Philadelphia social and gender history. She is responsible for reviewing grant materials for presentation of diverse cultures in Philadelphia.

Karie Youngdahl, College of Physicians of Philadelphia, is the Project Manager for the History of Vaccines. She is responsible for reviewing grant materials for the public presentation of the history of medicine.

Laura Zucconi, Associate Professor, Stockton College, is a historian of medicine who was co-PI for "Pox and the City: Edinburgh". She is responsible for playtesting the prototype in college history classes.

H. Digital media team

We are delighted to be working with Eduweb in developing the prototype for Pox in the City. With seventeen years of experience developing digital interactives for a range of audiences, Eduweb brings an exceptional ability to create engaging and effective online learning experience informed by current learning theory. Their museum clients include Colonial Williamsburg, Chicago History Museum, Detroit Historical Society, New York State Historical Association, Mount Vernon Garden and Estates, National Air & Space Museum, National Park Service, and the USS Constitution Museum. Their projects have won dozens of prestigious awards, including eighteen MUSE Awards from the American Association of Museums and four Awards of Merit from the American Association of State and Local History. Their work has won praise from the American Library Association, International Society for Technology in Education, Nobel Prize-winning physicist Riccardo Giaconni, and even *Entertainment Weekly* magazine.

David Schaller, Principal, is responsible for the overall creative direction of the project. Since 1996, he has been developing award-winning digital learning games and interactives for museums and educational organizations around the country. Schaller has over twenty years of experience in natural history and social science interpretation, working in print, exhibit, and digital media.

Susan Nagel, Educator and Treasurer, will be responsible for overall project management and playtesting for the alpha and beta versions of the prototype. Nagel is a licensed K-12 art teacher with years of experience teaching elementary, middle school and adult students.

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She has a B.A in American history from Carleton College and an M.Ed. from the University of Minnesota.

Steve Wagner, Graphic Designer and Illustrator, will have primary responsibility for the look and feel of Pox and the City. Wagner strives to create rich, captivating graphics while maintaining easy navigation and fast performance on the Web. Nagel has a B.S. in graphic design with a focus on multimedia and digital animation, and a Fine Arts minor from the University of Minnesota.

Paul Gardner, Web Developer, specializes in crafting code for interactive multimedia that runs on any browser or device. He also is careful to comply with W3C standards and ADA accessibility requirements. Gardner holds a B.F.A. from the University of Minnesota.

Russell Lunsford, Software Architect, will be the lead programmer for 3D game environment of *Pox in the City*. Lunsford has been responsible for the gameplay of MoonWalking and Betwixt Folly and Fate as well as our current 3D game projects in development.

Steve Adamson, 3D Artist, will have primary responsibility for character animation. His creative hand is behind many of Eduweb's human and animal characters for WolfQuest, Washington's World, and other 3D game projects.

I. State of the project

The idea of creating a digital role-playing game to explore the early history of vaccination began in 2010 as a series of conversations between Lisa Rosner and Laura Zucconi, from Stockton College, and Robert Hicks, of the College of Physicians of Philadelphia, about ways to make the outstanding collection of manuscript and print materials held by the College more accessible to the public. The College was just launching its own web-based inititiative, History of Vaccines (http://historyofvaccines.org), and had begun a series of outreach activities that have, in the interim, significantly increased its new media presence.

In 2011, Rosner and Zucconi successfully applied for $48,989 in funding from the Office of Digital Humanities to create the prototype, "Pox and the City: Edinburgh". From July 2011-October 2012, Rosner researched the history of vaccination, developing a set of storyboards and narrative arcs. The result was an adventure-quest game based in early 19th century Edinburgh. The lead character is a young Edinburgh physician who wished to use Jenner's vaccine to set up a practice; the choices players make during the game leads the physician on a sequence of branching paths. Edinburgh was chosen because of Rosner's expertise in the content area as well as the substantive archival record.

The prototype was built in a six-month period from October 2012-March 2013 by Elizabeth Goins, Ph.D., and a team of undergraduate interns at Rochester Institute of Technology. The result was a playable game in Flash, currently available at http://poxandthecity.blogspot.com. Playtesting was carried out by advisory board members from March-May, 2013. Rosner presented playtesting results at the CUNY Games conference in January 2014, and at the American Association for the History of Medicine conference in May 2014.

As a result of playtesting, as well as a series of discussions with the College of Physicians staff, advisory board members, and conference attendees, we decided to develop the game for public audiences, in keeping with the outreach mission of the Mütter Museum as well as current initiatives in the history of medicine. The game setting was switched from Edinburgh to Philadelphia in order to better engage Mütter audiences. An initial conversation with Dave

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Schaller at Eduweb indicated that the project was a good fit for their core competencies and led to the current collaboration.

J. Work plan
We anticipate the following schedule for the 19-month project period:

January 2015: Rosner and Theibault meet with Schaller for on-site planning meeting; Theibault will provide a write-up of this meeting and will send it to Advisory Board members for review. Rosner will use the meetings and feedback to prepare a work plan for additional historical research necessary for game development. Theibault will meet with Norwood to develop production schedule for project blog.

February 2015: Eduweb will provide a draft game design document; the Advisory Board will meet to review the document. Eduweb will revise based on feedback.

March 2015: Eduweb will carry out paper prototyping.

April 2015: Eduweb will produce the final game design document for production; Rosner will provide additional content development for game scenarios. Advisory Board members will review the additional content for historical and biological accuracy.

April-June 2015: Eduweb begins game production, produces first playable prototype.

May-June 2015: Theibault will meet with College of Physicians staff to plan for the Game Night at Philadelphia Science Festival. He will develop a detailed work plan for additional outreach efforts among Philadelphia science museums and potential funding partners.

July-August 2015: Eduweb creates the Alpha version of the game, carries out playtesting and revisions.

September-October 2015: Eduweb creates the Beta version of the game, carries out playtesting and revisions.

November-December 2015: Eduweb completes the prototype.

January-April 2016: Advisory Board members carry out playtesting and assessment.

April 2016: Schaller, Advisory Board members assist in featuring Pox and the City at the Mütter Museum's Game Night during the Philadelphia Science Festival.

May-July 2016: Rosner completes assessment, project white paper; Theibault develops detailed plan for next phase of the project.

K. Organization profile
The Richard Stockton College of New Jersey (http://www.stockton.edu) is a public, primarily undergraduate institution of liberal arts, sciences and professional studies. The College has gained distinction through its achievements, recognized by the Carnegie Commission as a "highly selective" liberal arts college. The Grants Office at Stockton College provides grant administration services that support scholarly projects broadly defined to include public programming as well as academic research.

Eduweb (http://eduweb.com) is an award-winning developer of digital learning games and activities. Since 1996, the company has developed over two hundred digital learning games and interactives for museums, zoos, and other cultural heritage organizations. Team members engage the many ways people learn with the thoughtful application of learning theory, imaginative conceptualizations, and unflinching evaluation. Broad experience in museum and K-12 education, combined with deep subject knowledge of art, history and science, fuels the company's commitment to develop compelling and effective learning experiences.

3. Pox in the City: Bibliography

Arthur, Brian. *The Nature of Technology.* New York: Free Press, 2009.

Bennett, Michael. "Smallpox and Cowpox under the Southern Cross: The Smallpox Epidemic of 1789 and the Advent of Vaccination in Colonial Australia." *Bulletin of the History of Medicine* 83.1 (2009): 37-62

Birch's Views of Philadelphia. Philadelphia: Free Library of Philadelphia, 2000.

Coxe, John Redman. "John Redman Coxe, 1773-1864". *University Archives and Record Center*, http://www.archives.upenn.edu/people/1700s/coxe_jno_redman.html).

Coxe, John Redman. *Practical Observations on Vaccination*. Philadelphia, 1802.

Delancey, Dayle. "Vaccinating Freedom: Smallpox Prevention and the Discourses of African American Freedom in Antebellum Philadelphia." *Journal of African American History* 95 (2010): 296-321.

Fenn, Elizabeth. *Pox Americana: The Great Smallpox Epidemic of 1775-1782*. New York: Hill and Wang, 2001.

Fields, Rebecca Green. "'Simple, Easy, and Intelligible': Republican Political Ideology and the Implementation of Vaccination in the Early Republic." *Early American Studies* 12.2 (Spring 2014): 301-337.

Finger, Simon. *The Contagious City. The Politics of Public Health in Early Philadelphia*. Ithaca: Cornell University Press, 2012.

Fisher, Matthew, and J. Moses, Rousing the Mobile Herd: Apps that Encourage Real Space Engagement. In *Museums and the Web 2013*, N. Proctor & R. Cherry (eds). Silver Spring, MD: Museums and the Web, 2013.

Gregory, John. "Instructions on inoculation for the smallpox." Case notes, directions, and prescriptions, National Archives of Scotland GD253/142/11/2.

Golden, Janet. "Medical History in Other Venues: Theater, Festivals, Blogs, Digital Games, and More." AAHM Annual Meeting, Chicago, May 2014.

Gronim, Sara. "Imagining Inoculation: Smallpox, the Body, and Social Relations of Healing in the Eighteenth Century." *Bulletin of the History of Medicine* 80.2 (2006): 247-268.

Gross, CP, Septkowitz, KA. "The myth of the medical breakthrough: smallpox, vaccination, and Jenner reconsidered." *International Journal of Infectious Diseases*, 3.1 (1998): 53-60.

History of Vaccines. College of Physicians of Philadelphia, http://historyofvaccines.org .

Hughes, Thomas. *Human Built World*. Chicago: University of Chicago Press, 2004.

Hunter, Robert. "The Origin of the Philadelphia General Hospital." *Pennsylvania Magazine of History and Biography* 57 (1933): 32-57.

Jenner, Edward. *An Inquiry into the Causes and Effects of the Variolae Vaccinae,* London, 1801.

Jenner, Edward. Letter to the Royal College of Physicians of Edinburgh, London, 20 July 1806. Library of the Royal College of Physicians of Edinburgh Mss.

Klepp, Susan. *"The Swift Progress of Population": A Documentary and Bibliographic Study of Philadelphia's Growth, 1642-1859*. Philadelphia: American Philosophical Society, 1991.

Lindee, M. Susan. "The American Career of Jane Marcet's Conversations on Chemistry, 1806-1853." *Isis* 82 (1991): 8-23.

Marcet, Jane. *Conversations on Chemistry*. London, 1806.

McNeill, William. *Plagues and Peoples*. New York: Doubleday, 1976.

Nash, Margaret. "Rethinking Republican Motherhood: Benjamin Rush and the Young Ladies' Academy of Philadelphia." *Journal of the Early Republic* 17 (1997): 171-191.

Newman, Simon. *Embodied History: The Lives of the Poor in Early Philadelphia*. Philadelphia: University of Pennsylvania Press, 2003.

Offit, Paul. *Deadly Choices. How the Anti-Vaccine Movement Threatens Us All*. New York: Basic Books, 2012.

Otter, Samuel. "Philadelphia Experiments" *American Literary History* 16.1 (2004): 103-116.

Porter, Roy. "The Patient's View: Doing Medical History from Below." *Theory and Society* 14.2 (1985): 175-198.

Prospect of Philadelphia and City Directory, 1795.

Ramirez, Paul. "'Like Herod's Massacre': Quarantines, Bourbon Reform, and Popular Protest in Oaxaca's Smallpox Epidemic, 1796-7." *The Americas* 69.2 (2012): 203-235.

Riley, James. "Smallpox and American Indians Revisited." *Journal of the History of Medicine and Allied Sciences* 65.4 (2010): 445-477.

Rosner, Lisa. "It's How You Play the Game: Playtesting Pox and the City, A Medical History Game." Presented at CUNY Games Festival, New York, January 2014 and AAHM Annual Meeting, Chicago, May 2014.

Rosner, Lisa. "Thistle on the Delaware: Edinburgh Medical Education and Philadelphia Practice 1800-1825." *Social History of Medicine* 5 (1992): 19-42.

Rusnock, Andrea. "Catching Cowpox: The Early Spread of Smallpox Vaccination, 1798-1810." *Bulletin of the History of Medicine* 83.1 (2009): 17-36.

Schaller, David. "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, 2011.

Schell, Jesse. *The Art of Game Design. A Book of Lenses*. New York: Morgan Kaufmann, 2008.

Schillace, Brandi. Review of "Pox and the City". *Bull. of the History of Medicine* (under review).

Scott, Anne Firor. "The Ever Widening Circle: The Diffusion of Feminist Values from the Troy Female Seminary 1822-1872." *History of Education Quarterly* 19.1 (1979): 3-25.

Sellers, Charles Coleman. *Mr. Peale's Museum. Charles Willson Peale and the First Popular Museum of Natural Science and Art*. New York: Norton, 1980.

Sköld, Peter, "From Inoculation to Vaccination: Smallpox in Sweden in the Eighteenth and Nineteenth Centuries." *Population Studies* 50.2 (1996): 247-262.

Small Pox Destroys, Vaccination Saves, the Lives of Thousands. Philadelphia, 1806.

Swinney, Daniel J. "Vaccination Records 1811-1816." College of Physicians of Philadelphia Cage MSS 2/0085-01.

Tolley, Kimberley. *The Science Education of American Girls*. New York: Routledge, 2003.

Views in Philadelphia and Its Vicinity: Engraved from Original Drawings. Philadelphia, 1827.

Waterhouse, Benjamin. *Harvard University Library Open Collections Program*, http://ocp.hul.harvard.edu/contagion/waterhouse.html.

Weaver, Karol Kovalovich. "The Enslaved Healers of Eighteenth Century Saint Domingue." *Bulletin of the History of Medicine* 76.3 (2002): 429-460.

Willard, Emma. "Improving Female Education 1819." http://www.emmawillard.org/archive/mrs-willards-plan-education

Willrich, Michael. *Pox: An American History*. New York: Penguin, 2012.

Willson, Joseph. *The Elite of Our People: Joseph Willson's Sketches of Black Upper-Class Life in Antebellum Philadelphia*. State College, PA: Pennsylvania State University Press, 2000.

Youngdahl, Karie. "Testing a Smallpox Digital Game." *History of Vaccines Blog*, 2013, http://www.historyofvaccines.org/content/blog/testing-smallpox-digital-game

8. Pox in the City: Design Document

1. Executive Summary

1A. Goals of the Project

Pox in the City has been designed to provide fun, meaningful gameplay while engaging players with rich historical content about a critical moment in the history of medicine. A good game engages the player's imagination, fosters motivation, offers context, and provides scaffolding, all within a structured, rule-based world. In a digital game, designers can recreate the rules of nature and society in a virtual world that puts players in authentic historical situations. There they must analyze information, weigh choices, make judgment calls, and — to succeed — develop a robust understanding of the underlying humanities content that informs the game world.

Pox in the City will do all of that. As the game begins, players step into the shoes of a young physician who has arrived in 1802 Philadelphia just as a smallpox epidemic erupts. Armed only with Jenner's new vaccination technique and a will to succeed personally and professionally, players undertake the grand challenge of stopping the disease in its tracks by persuading patients to be vaccinated. Accomplishing that requires engaging with the core mechanics of the game, which model a fundamental analytical framework for the history of medicine: the three-way interaction between the disease entity, the healer, and the patient.

As players learn and ultimately master the rules of the game, they are also learning to recognize contours of that interaction as well as the social, intellectual, and cultural history that influences and constrains it. Players must understand the nature of Jenner's innovation, as well as the reasons for resistance to it. They must learn the social geography of the city, and then apply their knowledge to game choices. The more detailed knowledge they acquire of actual neighborhoods, as well as social, intellectual, and religious networks, the more successful they will be in earning their patients' trust. By probing, hypothesizing, interpreting consequences, and revising their understanding of the game, players develop their own mental model of the three-way interaction in far more profound and affective ways than they would by simply reading about it. They can use that analytical framework when exploring other aspects of the medical humanities.

1B. Rationale for the platform

We plan to build the game using Unity3D, the premier game-authoring tool, and deploy to the web as well as iPad and other tablets. All game text will be contained in xml files to simplify access and editing. Eduweb has Unity Pro licenses for all relevant platforms, including Web, iOS, and Android. The company also has an extensive library of 3D character art appropriate to the historical time frame.

1C. Humanities Content

Pox in the City directly ties humanities content into gameplay. A map of the city provides a strategic overview of the social geography of the city. As reports arrive from neighborhoods rich and poor, players plot the spread of the disease. Patterns of contagion emerge, forcing players to make hard choices about where to devote their efforts. Should they favor the wealthier residents, who pay their bills promptly and keep their doctors in

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business? Or should they focus on the poorer zones where the virus spreads rapidly and poses the greatest threat to the public health of the city? And since Philadelphia is the new republic's largest port, with burgeoning commercial and scientific networks extending north, south, and west, a smallpox outbreak could be as devastating as yellow fever in 1793, decimating cities and settlements up and down the seaboard and extending west across the continent.

At the heart of the game is the trust relationship between the physician (player character) and potential patients (NPCs, non-player characters). Jenner's vaccination is Philadelphia's best public health defense against smallpox, because it stops the virus in its tracks. Once vaccinated, residents can neither contract the disease nor spread it. If enough residents are vaccinated, they become barriers against the virus, a process known as herd immunity.

But people are not brick and mortar barricades, and the history of vaccines has made clear the degree of opposition the process has engendered. Only if individual patients trust their doctors, and trust the science behind the vaccination, will they agree to the process.

As players visit each neighborhood, they must choose the best tactics to earn each patient's trust. Should they take the direct route, going house-by-house and persuading people to be vaccinated? Or is it more effective to appeal to residents through ministers and other neighborhood leaders? Would it be most efficient to establish a public dispensary, and make patients come to them? If so, what would be the best location? Dare they teach local midwives how to vaccinate, vastly increasing their reach but risking their professional standing? Will seeking the aid of city officials help them gain their patients' trust – or instead embroil them in party politics? The game play makes these decisions follow historically accurate scenarios.

Throughout the game, players also collect stories from neighborhoods and social networks of 1802 Philadelphia. For example, through encounters with African Americans in the waterfront neighborhoods, players obtain accounts of their experiences as care givers during the Yellow Fever epidemic. Elite women tell stories about their philanthropic and popular science networks. Every neighborhood or network has a story, which players collect piece by piece, in fragments from residents who they persuade to be vaccinated. Only after they've collected all fragments for a neighborhood or network will those residents trust the player enough to allow comprehensive vaccination of the group, both ensuring its safety and establishing another barrier against the virus.

Through it all, players must learn to think like the virus, anticipating its next move in order to block its advance. And they must learn how the city works: who lives where, what conditions obtain in one neighborhood compared to another, and most importantly how the web of human connections that knits the city together also offers invisible conduits for the virus.

Over the course of the game, players measure their success in several ways: the number of individuals vaccinated, the number of neighborhoods made safe against the virus, as well as their own income and reputation. Certain actions will reward the player more in one metric than another, so those consequences will also inform the player's choices of strategies and tactics.

We have in place a significant number of assets for use in implementing the prototype. The map of Philadelphia will be based on contemporary documents such as

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Charles Varle's 1802 "Plan of the City". Development of the 3D gamespace will also be based on contemporary illustrations, such as William Birch's *Views of Philadelphia*. We have digitized the information in the 1795 city directory, *The Prospect of Philadelphia*, which provides street-by-street information on residents and their occupations. This will provide accurate historical information on neighborhoods and social and occupational networks. We will also use the bills of mortality published in Klepp's *The Swift Progress of Population* to ensure that the medical information presented in the game is historically accurate.

The game will be designed initially for the city of Philadelphia, but it will be structured to facilitate future versions for other cities with similar health histories. Both Boston and New York City were burgeoning commercial centers in the early 19th century and, like Philadelphia, were vulnerable to small pox outbreaks. In each city, certain physicians chose to adopt Jenner's vaccine as their path towards professional success, using it to establish a practice among the wealthy while setting up vaccine dispensaries for the poor. Patterns of resistance to the innovation, social geographies of the cities, and local government interest in public health, were also similar. We believe, therefore, that careful attention to design and structure of the prototype will yield a game with far-reaching applications. It has the potential to increase awareness of the humanities content far beyond our current target audience.

2. User Experience

2A. Design Objectives

Design objectives for the user experience of *Pox in the City* have been developed both from evaluation of playtesting for the medical history game "Pox and the City: Edinburgh" (Youngdahl, 2013; Rosner, 2014; Schillace), and from Eduweb's extensive experience in game design for public programming. All these design objectives are informed by current research on the diversity of the user experience in game play designed for museum and other public spaces (Schell, 2008; Schaller, 2011; Fisher and Moses, 2013).

Playtesting "Pox and the City: Edinburgh"

Three of our design objectives for the user experience emerged from playtesting "Pox and the City: Edinburgh": a sense of place that links the real world to the game world, game play that encourages diverse playing styles, and game design that fosters social interaction. "Pox and the City" is a narrative adventure game set in Edinburgh, Scotland, in 1802, in which a young physician moves through the city on a series of quests in order to vaccinate patients of diverse social and economic backgrounds. The "win" condition is to set up a public dispensary, but in actual gameplay, there is no single way to win. Instead, the player can choose to play as either an "entrepreneurial" or as a "philanthropic" doctor. The former, if followed consistently, leads to wealth, fame, and an urban elite practice, while the latter leads to more modest, yet no less satisfying success with a country practice. Developed with an NEH Digital Humanities Start-up Grant, it has been well reviewed by historians of medicine and digital humanities scholars for demonstrating the power of interactive games in presenting medical humanities content.

The most comprehensive playtests were carried out by high school science students, who received extra credit for writing 2-3 page evaluations of their experience. They were overwhelmingly positive about the history of medicine content of the game, which was highly successful in sparking their interest both in concrete medical practices, and in the doctor-patient relationship during the historical period.

Playtesting showed us, though, that students had difficulties envisioning the world of early 19th century Edinburgh, because they had very little knowledge of the history and culture of the city. For that reason, we made the key decision to move the setting of the game from Edinburgh to Philadelphia. We feel that situating a medical history game in a location that players would be more familiar with would make the game more comprehensible and enjoyable, without compromising the medical and social history content. We also decided to emphasize the sense of place created by playing the game in a venue that has a direct connection to the game content. To foster this sense of place, we will be incorporating the College of Physicians itself as a location within the game. We will also seek permission from other Philadelphia historical institutions, such as the American Philosophical Society, the Library Company, and the Academy of Sciences, to include them as locations within the game.

Another key decision was to incorporate different kinds of play into the core game mechanic. We found that different groups within our playtesters played the game in different ways, and that gender differences were particularly striking. Female students outnumbered males among our high school playtesters by two to one. They played it as an interactive story: they were interested in the character of the physician and in his relationships with NPCs. They understood the "win" condition of the game as becoming a socially conscious physician and saving lives: almost invariably they chose to play as a "philanthropic doctor." Male students were much less interested in the story and characters. They most frequently played as an "entrepreneurial" doctor, and they typically ignored the story line in order to concentrate on the strategy of attracting wealthy patients.

Both modes of play demonstrated engagement with the humanities content. The female students were most interested in the historical narrative and the social history materials incorporated into player-character and NPC relationships. The male students were successfully modeling actual early 19th century professional behavior by attempting to maximize their own social and economic position. Our current game will build on these insights by incorporating both types of behavior – discovering stories and plotting strategy – into intentional game play. We have designed our current game to require both strategic thinking, as players plot their activities on the map of Philadelphia, and understanding relationships among the player character and NPCs, as players seek to earn their patients' trust. The final component of gameplay necessary to secure a neighborhood or social network against the virus will be successful assembly of a story integral to that neighborhood. We expect this to be highly satisfying to players, with an emotional resonance analogous to fitting in that last piece of a jigsaw puzzle.

A final feature of playtesting had to do with players' enthusiasm for working in teams. We had assumed that players would prefer to play in isolation on their computers, but instead they preferred cooperative groups. We have therefore designed our current game so it can either be played solo or as a multiplayer game of 2-4 players. When playing solo, players will take on the role of a single physician, fighting against the virus.

They will model the historical experience of physicians like John Redman Coxe and David Swinney, two of Philadelphia's innovators in promoting Jenner's vaccine. When playing against other people, players will model the historical experience of physicians in the competitive Philadelphia medical marketplace, trying to protect their patients while ensuring their own professional and economic success. In both versions, players will try to win "reputation" points by vaccinating the most patients and protecting the greatest area of the city, but they will lose points if their unprofessional competition allows the virus to spread. They will also be subject to chance: one player's vaccine may turn out to be ineffective, allowing another player to vaccinate "his/her" patients. Or a patient of humble social origins – a former Revolutionary War private turned bricklayer, for example -- may turn out to have a wide circle of influential connections in military circles, and thus help players extend their trust relationships.

One of the most exciting features of the game is that it offers the possibility that players can join forces and play as a team. Players might choose to work cooperatively by dividing up Philadelphia into sections or networks, so as to save the city from the virus that much faster. This would model the historical development of philanthropic public health organizations such as the Society for Promoting Vaccination, as described in the excerpt from the *Eclectic Repository and Analytical Review* (American Periodicals Online, Proquest), below.

MEDICAL AND PHILOSOPHICAL INTELLIGENCE.

VACCINATION.

The following important statement, from the annual official reports of the Board of Health, with the account of persons vaccinated by the society for promoting vaccination, must be peculiarly interesting and conclusive, in respect to the benefits of this invaluable discovery. By the reports of the Board of Health, it appears, that there have died of inoculated and natural small-pox in the city of Philadelphia and its neighbourhood—

In 1807,	32 Persons
1808,	143
1809,	101
1810,	140
1811,	117
1812,	NONE.

In 1809,	1102	Persons were successfully vaccinated by the Physicians of the Society for Promoting Vaccination, in the city and neighbourhood of Philadelphia.
1810,	955	
1811,	1277	
1812,	1255	
Total,	4589	

June 26, 1813.

Our playtesting suggests that playing as a "Physician of the Society for Promoting Vaccination" might be an especially popular option for the young women who chose to play as a "philanthropic" physician. It could also be used to broaden future game applications to include public programming in the history and practice of public health.

Cooperative play also would also make it possible for teams of players to work together, while competing against other teams to be the first to vaccinate the entire city. This is a particularly powerful approach to public programming, as it is compatible with successful events such as the annual Murder at the Mütter, which invites audience participation in solving a murder mystery. Typically people attend these events in groups of twos or threes, with the goal of successfully solving the puzzle. We believe that a

Game Night involving a team-based, 3D medical history game would attract even wider audiences to the Mütter Museum.

Eduweb Historical Games

Design objectives for the *Pox in the City* user experience have also been developed based on Eduweb's extensive portfolio of historical games. *Pox in the City* will require players to evaluate evidence and make thoughtful decisions about the best ways to accomplish their goal of stopping the advance of the virus. Such decisions are at the heart of many historical games that Eduweb has developed over the years. It will build on Eduweb's expertise in developing algorithms that model real-world structures, as well as its extensive experience with 3D game design. The samples below will illustrate aspects of previous Eduweb games that are applicable to *Pox and the City*.

The decision-making process in *Pox and the City* can best be seen in "Building Detroit" (http://detroithistorical.org/buildingdetroit/). Each decision has consequences, so the player must then evaluate their new situation before making their next set of choices. As each level progresses, players take on the role of one of their children from the previous level, deciding who to marry, how to raise their children, and what job to do based on the career choices of that time period.

Over the course of the game, players develop a lasting impression of what their lives might have been like in the historic times that shaped Detroit.

Similarly, in "A Sailor's Life for Me!" developed with the USS Constitution Museum (http://www.asailorslifeforme.org), players enlist in the Navy and come aboard Old Ironsides during the War of 1812 and make daily choices in the face of ordinary events that greatly affect their advancement aboard the ship.
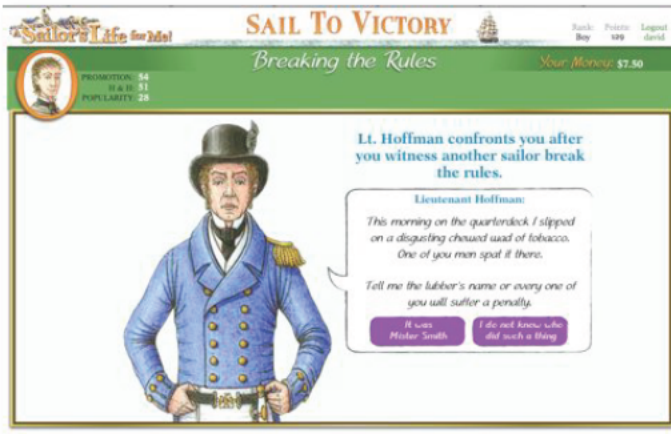
Each of these games won a MUSE Award from the American Association of Museums and an Award of Merit from the American Association of State and Local History.

In *Pox in the City*, every decision will feed into the underlying game logic to be processed by algorithms that model social structures and virus transmission in 1802 Philadelphia. Eduweb has produced many games that model real-world systems, such as "London Factor," a game about global trade in the eighteenth century developed with Colonial Williamsburg. Player choices percolate through the game, sometimes with unanticipated consequences, but always revealing the connections that characterized the phenomenon of eighteenth-century mercantilism.
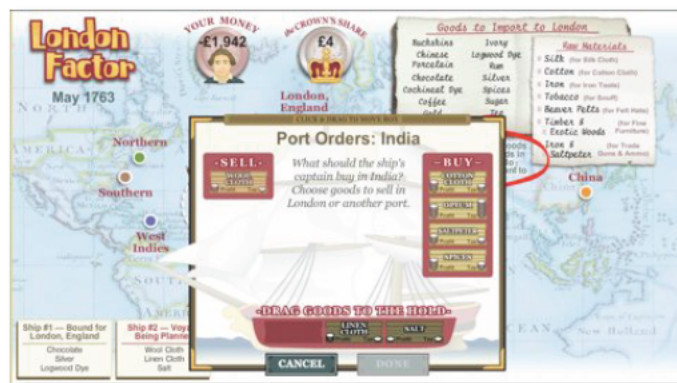
In *Pox in the City*, some decisions will be presented in dialogs with NPCs such as neighborhood residents, other physicians, and potential allies, thus revealing possible courses of action as well as the human and cultural fabric of that time and place. Eduweb has developed many games with these types of interactions, often in a 3D virtual world that recreates a historic site. For example, in "Betwixt Folly and Fate," developed with Colonial Williamsburg (http://www.history.org/history/teaching/dayinthelife/interact_role.cfm), players assume one of four roles, from enslaved house servant to young gentleman, and navigate a typical day while facing decisions that will reverberate through a lifetime.

"Betwixt Folly and Fate" won a Gold MUSE Award from the American Association of Museums.

2B. User Experience: Walk-through

Pox in the City is designed to have a territorial and persuasion game mechanic rather than a linear progression through levels. The initial view is analogous to Risk, in that players will start off with the map of Philadelphia, and must decide which section to target. The red markers record known cases of smallpox. Not surprisingly, they are clustered around the waterfront, the primary site of population movement into and out of the city. But what could account for the cluster of cases around Elfreth Alley? Could it be

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the large number of boarding houses located on the street? And how about the cases over by the Schuylkill?

Players will have to investigate existing cases to learn more about the spread of disease. Having chosen a neighborhood from the map view, they must then visit the neighborhood in order to interact with inhabitants.

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As the scene indicates, physicians typically made house calls to well-off patients in the late morning. This was the time of day when most residences caught the most sunlight, facilitating the close observation needed for diagnosis and treatment. It was also the period when the mistress of the household was most likely to be at home, and before the hour when she might be receiving visitors. Children, too, were likely to be home, especially if the household had received word that there was sickness in the neighborhood.

Having met with residents, players will then return to the map-view, evaluate the situation, and decide on next steps. If the household has agreed to be vaccinated, they might choose to visit another resident in the same neighborhood, or to choose a different neighborhood. If not, players might choose to look for allies in the attempt to persuade residents to be vaccinated.

Library Hall, pictured below, was built in 1789-90, and in 1802 housed the Library Company of Philadelphia and the University of Pennsylvania Medical School. The College of Physicians of Philadelphia met just across the street, at the American Philosophical Society.

Surely the cluster of expertise would make Library Hall an excellent location for a young physician to seek information and advice on how to prevent the spread of smallpox throughout the city.

Historical Sources

To ensure historical accuracy for the map view, we are using John Hill's "Plan of the City of Philadelphia and Environs" (1807) together with Charles Varle's "New Plan

of the City and Environs" (1802). Although some of Varle's projected streets and squares were never built, the map is accurate for the eastern part of the city.
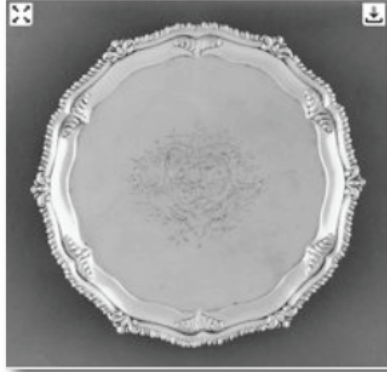

Greater Philadelphia GeoHistory Network,
http://www.philageohistory.org/rdic-images/index2.cfm?w=237-MP-019

David Rumsey Maps,
http://www.davidrumsey.com/luna/servlet/detail/RUMSEY~8~1~205~
20052:Philadelphia-#

The Philadelphia Museum of Art has an extensive collection of period furnishings and artifacts, such as this silver salver, made by Richard Humphreys, a Philadelphia silversmith and merchant. It is the source for the salver in the map view, above.

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William Birch and other contemporary engravers have provided rich visual imagery of Philadelphia in the early 19th century. Birch's engraving of Library Hall made artful use of perspective and a naturalistic style to enable contemporary viewers to feel as though they could walk right into the image. Eduweb's version of the street scene is fully in keeping with the historical document on which it is based.

LIBRARY and SURGEONS HALL, in Fifth Street PHILADELPHIA.

Game Components

Our preliminary list of game components includes:

- Map:
    - Provides an overview of the situation, indicating the status of each neighborhood. The player begins with no status information and must expend resources to collect information from each area of the city.
    - The map also serves as a navigation tool for choosing which neighborhood to visit.
    - The map is designed to present historically accurate information of the social geography of Philadelphia in 1802. The health factors (see below) will also reflect historical conditions.

- Smallpox virus: The opponent. Using biologically accurate game AI, the virus is actively trying to spread through the city via geographical and social connections. Soldiers and sailors might bring the virus through the ports or navy yards; travellers might infect entire boarding houses; carpenters and painters might spread it as they ply their trade throughout the city. Farmers might help the virus to spread as they bring their goods to market. Even gentlemen's and merchant's households might become an active locus for the spread of infection, through traditions of hospitality that welcomed guests and their servants.

- Neighborhoods:
    - Aggregate of family NPCs (who represent entire neighborhood population).
    - Has several status levels, based on statistics of herd immunity: No virus, isolated cases, outbreak, epidemic
    - Example: African American communities clustered around the dockyards and Rev. Richard Allen's African church on Sixth Street

- Family NPCs:
    - A wide variety of families, representing different socioeconomic and ethic groups
    - Each family's AI (which determines their responses to player actions) reflects their identity
    - Players interact with families through dialogue
    - Each family has one piece of their neighborhood's story

- Networks
    - Behave like neighborhoods but may have more complex geospatial relationships
    - Examples: sailors living on Market Street, Mifflins Alley and Pewter-Platter Alley; Fellows of the College of Physicians, clustered on Market Street and the streets around Library Hall but also extending into the suburbs; students and teachers at the Young Ladies Academy of Philadelphia; subscribers to Birch's *Views of Philadelphia* residing throughout the city.

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- Potential ally NPCs:
  - Ministers, midwives, public officials
  - Each ally's AI reflects his/her identity.

  Ministers often took leading roles in persuading their congregations to agree to vaccination, and physicians regarded them as natural allies.

  Midwives occupied a more ambiguous role. In public pronouncements, Philadelphia physicians, like their counterparts in other urban centers, were agreed that only properly educated physicians could vaccinate patients. When vaccination went wrong, they were quick to accuse "ignorant midwives" and "quacks" of carrying out the procedure incorrectly. There is evidence, however, that some midwives were as eager as physicians to take advantage of the professional opportunity afforded by the new technique. Moreover, although scholars have focused on the competition between male physicians and midwives, there is also evidence that some male physicians made alliances with especially well-connected midwives in order to ensure that they, rather than their competitors, were called in difficult cases. An alliance with a midwife might be a complicated balancing act, between the access it might afford to patients, and the loss of reputation that might result if it became known to professional competitors.

  Alliances with public officials might also prove a complicated balancing act. Philadelphia city government was known for political infighting, especially over matters of public health, in which one side's "measures for the public weal" might look to the other like "unlawful restriction on commerce and liberty".
  - Player interacts through dialog to persuade them to join forces to stop the outbreak

- Medical practitioner NPCs
  - Both elite (Fellows of the College of Physicians of Philadelphia, medical professors at the University of Pennsylvania) and non-elite practitioners (surgeons, apothecaries)
  - Each holds a particular view about the pox and prevention methods
  - Player interacts through dialogue
  - Some physicians can be persuaded to join forces. Others work in opposition to players, seeking their own professional advantage.

- Control methods: Each method has set of probabilistic attributes, such as success rate and risk of contagion
  - Regimen: prescription of clean water, healthful food, rest (what we would now understand as methods for strengthening immune system)
  - Pre-Jenner inoculation: may protect the patient but will still spread infection
  - Vaccination
  - Heroic treatment: interventions for treating smallpox, including bleeding, purging, and sweating

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Additional components based on the humanities content will be developed during the game design process.

3. Technical Architecture

We will build the game in Unity3D and publish for the Web and mobile devices. We do not anticipate any user-generated content.

4. Sustainability Plan

Once the prototype is completed and assessed, we expect to use it to seek additional funding to build the full game. We anticipate that the game could be completed in 18-24 months. That additional funding would also cover web hosting costs and minor technical modifications. The Unity game engine is robust and is expected to remain a game design standard for the lifetime of the project. We expect that Stockton College and the Mütter Museum will be able to provide access to the game through their respective websites.

We are enthusiastic about *Pox in the City*, because we believe there is a call for a medical and science history game that can be used by medical heritage institutions and science museums as part of their public programming. During the Philadelphia Science Festival (http://www.philasciencefestival.org), science heritage institutions, including the Academy of Natural Sciences and Bartram's Garden as well as the Mütter Museum, provide field trips and hands-on activities for adults, families, and schools. Many of these involve games and puzzles, such as content-specific Quizzo, scavenger hunts, and the Mutter's own Murder at the Mütter, in which participants use historical and forensic clues to solve a murder mystery. Philadelphia-area science heritage institutions also collaborate in developing programming for Science on Tap (http://scienceontapphilly.com), which features monthly presentations by a wide range of scholars on history, culture, and current debates in science at the historic National Mechanics bar and restaurant. Philadelphia also has a very active Nerd Nite series (http://philadelphia.nerdnite.com/), which often combine humanities content with science and spectacle to engage adult audiences. We expect that the audiences who attended to learn about "Confessions of a 19th Century Skull Collector" (a discussion of the Samuel George Morton Cranial Collection, http://www.upenn.edu/spotlights/penn-museum-skull-collection and "Not Your History Teacher's Thomas Jefferson" (in connection with the American Philosophical Society's exhibit, http://www.apsmuseum.org/jefferson-philadelphia-and-the-founding-of-a-nation/), will also be excited by *Pox in the City*.

The complete game version of *Pox in the City* will be designed to be specific to the history and culture of early 19th century Philadelphia. Two members of our advisory board, Lisa O'Sullivan and James Edmonson, are eager to investigate ways in which it can be adapted for programming for their own institutions. It would be a natural extension of the goals and humanities content of this project to develop city specific versions, so that *Pox in the City: Philadelphia*, created in partnership with the College of Physicians of Philadelphia, might be followed by *Pox in the City: New York*, created in partnership with the New York Academy of Medicine. Both cities had similar public health histories, comparable immigrant and African American populations, and similar experiences of the introduction of Jenner's vaccine. Instead of Varle's and Hill's maps of Philadelphia, game designers would substitute contemporary maps of New York. Instead

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of Drs. John Redman Coxe and David Swinney, the physician-character might be based on Drs. Samuel Bard and Robert Schofield. Instead of the College of Physicians of Philadelphia, physician NPCs might belong the College of Physicians and Surgeons of New York. Instead of going to Library Hall, the players might seek allies at Columbia College or the New-York Society Library. While this revision would require new art assets for buildings and interiors, and new text for dialogue, it would not be difficult to adapt the core mechanic and game engine to the new setting.

Adapting *Pox in the City* to later smallpox outbreaks, such as the one that ravaged Cleveland in 1902, would again require a complete overhaul of art assets for maps, backgrounds, interiors, character appearance, and dialogue. But the core mechanic and game engine could readily be repurposed to engage players in the new historical time period.

We recognize that any extension to *Pox in the City* would require additional funding not covered by the present proposal.

5. Narrative Treatment

This section is not relevant for our project.