TO INOCULATE OR VACCINATE: THAT HAS ALWAYS BEEN THE QUESTION

by

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A Project

Presented to

The Faculty of Humboldt State University

In Partial Fulfillment

of the Requirements for the Degree

Masters of Social Science

Emphasis in American History

May, 2005
TO INOCULATE OR VACCINATE: THAT HAS ALWAYS BEEN THE QUESTION

by

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ABSTRACT

To inoculate or vaccinate: that has been the question regarding the threat of smallpox. The scourge of smallpox has plagued mankind for centuries. Its effects, upon arrival in the New World, if anything, were magnified, especially among the native populations. Yet, even among the flood of northern European pioneers, pilgrims, and paupers, periodic smallpox epidemics decimated the population. The introduction of the inoculation from the Middle East in the early eighteenth century offered a respite, if not a solution, to the terror.¹

However, while the inoculation procedure resulted in a yet-unexplained less virulent form of smallpox and granted life-long immunity, it also killed about one percent of its patients and could still transmit the disease to others. Because of its danger and required quarantine period, smallpox continued its rampage.²

During the American Revolution, the impact of a North American pandemic created a crises for both Rebels and Loyalists. Washington, a smallpox survivor himself, struggled to create an army while the pox snuffed his ranks. Indeed, smallpox and winter combined to stop an American drive on Quebec.³ African-American slaves who answered the call of Virginia’s governor to win their freedom were cut as if by grape shot by the smallpox virus.

Edward Jenner’s discovery in 1796 that a cow pox vaccination⁴ proved pivotal in the battle against smallpox, although it did not provide lifetime immunity as he initially
claimed. Because it too was not risk free, the debate over its use raged on until the 
scourge was declared eradicated in 1980.  

This study will trace the inoculation and vaccination controversy from the 
eighteenth century through the present, examining the risks versus rewards each has 
presented in turn to the populations involved. The contentious debates that swirled 
around the religious, social, economic, and medical reasons to inoculate and later, 
vaccinate, in eighteenth through the twentieth century, will be addressed and viewed in 
the light of recent events involving the threatened use of bioterror weapons like smallpox 
in a country once again virtually defenseless against such a scourge.  

Within the classroom, students will read and examine historical documents, maps, 
letters, photographs, drawings, and charts to:

1. Understand that some things change in the course of history and some things do not.
2. Understand the impact of smallpox as well as its cure in America history.
3. Understand that smallpox is also an issue today with potential consequences as grave 
as those in colonial times.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>v</td>
</tr>
<tr>
<td>IS THE CURE WORSE THAN THE DISEASE?</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Inoculation During the Colonial Era 1721-1781</td>
<td>8</td>
</tr>
<tr>
<td>The Role of Smallpox Vaccination in the Nineteenth Century</td>
<td>18</td>
</tr>
<tr>
<td>Contemporary Views on Smallpox</td>
<td>25</td>
</tr>
<tr>
<td>LESSON PLANS</td>
<td>31</td>
</tr>
<tr>
<td>Introduction</td>
<td>31</td>
</tr>
<tr>
<td>Prior Content Knowledge and Content</td>
<td>35</td>
</tr>
<tr>
<td>Discussion of Content Hook</td>
<td>36</td>
</tr>
<tr>
<td>Lesson Content</td>
<td>37</td>
</tr>
<tr>
<td>Appendix A Grade 5 National History Standards</td>
<td>50</td>
</tr>
<tr>
<td>Appendix B Exam</td>
<td>53</td>
</tr>
<tr>
<td>Appendix C Images</td>
<td>57</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>66</td>
</tr>
<tr>
<td>ENDNOTES</td>
<td>69</td>
</tr>
</tbody>
</table>
IS THE CURE WORSE THAN THE DISEASE?

Introduction

In the world of disease, one statement should be unequivocally true: smallpox has been eradicated forever. After 1980 this seemed to be the case worldwide. This scourge, which had wiped out kings and peasants, popes and paupers, had itself been rendered harmless by a determined international effort led by the World Health Organization. Aside from two experimental batches, one in the United States and the other in the then Soviet Union, smallpox as a contagion was dead. 6

So why is smallpox in the news at all today? In large part because international terrorism and terrorists may have access to one of those experimental batches left over from 1980. Perhaps even more frightening is the possibility that there may not only be enough vaccine to protect a virtually defenseless public but also a vaccine that may, in fact, debilitate or even kill more people than the disease itself. 7

Historically, smallpox as a course of study has been on a global scale. Yet there is no definitive work on the influence of both inoculation and later vaccination within the context of American history on the disease itself. Scholars such as Jared Diamond in Guns, Germs, and Steel, William McNeill in Plagues and People, and Joseph J. Ellis in His Excellency, George Washington, have examined the significance of smallpox in the rise and fall of city-states, countries, nations, and civilizations throughout history, but
because their works deal with much wider themes and subjects, much of the background behind a disease such as smallpox is missing.

Another work, like that of John Duffy’s *Epidemics in Colonial America*, takes a much narrower focus on a specific time period, providing much more detail about the background of the smallpox and the newly introduced inoculation to stem its unrelenting toll among Colonial Americans, but because he also examines the influence and impact of other diseases from agues to venereal as well, the scope and detail are lacking.\(^8\) Elizabeth Fenn’s *Pox Americana* does the same, in the sense of examining a specific event, in this case the North American smallpox epidemic that coincided with the American Revolutionary War from 1775 - 1781. However, she provides a wealth of background material that explains not only episodes of fear and superstitions generated by smallpox but also the story behind those who sought to contain it through quarantine and later variolation, or inoculation.\(^9\)

Because Fenn’s book coincides with the American Revolutionary War, she also weaves the American and British campaigns within the reality of the epidemic that has not been an integral part of the general studies of the period. Fenn links the disastrous American invasion of Canada with an outbreak of smallpox that decimates the Patriot forces before and after the crucial Battle of Quebec City in late 1775, thwarting what would have been an opportunity to seize Canada and perhaps change the entire early course of the war in the North. Not long afterwards in early 1776, the collapse of Lord Dunsmore’s Black Ethiopian regiment of Loyalist slaves, ravaged by a smallpox epidemic, seeking their freedom from Patriot owners, may have altered the campaigns in
the Tidewater region. These and other bouts of smallpox that left the American forces as vulnerable to this scourge as British bullets and bayonets ultimately influenced George Washington’s decision to inoculate all the troops under his command by 1777. 

In a detailed article in *The Journal of American History* and, to a lesser extent in her book, Fenn postulates that biological warfare was waged, using blankets infected with smallpox as well as contagious patients, in the earlier Indian wars and later in the Revolutionary War. She examines Sir Jeffery Amherst letters and communiqués with subordinates on how smallpox-infected blankets might have been, and in fact, were used as a biological weapon against Native American foes. This link between biology and war seems all the more remarkable, and troubling, in light of the direct terrorist attack on the United States on September 11, 2001.

With *The Greatest Killer: Smallpox in History*, an update of his 1983 book, *Princes and Peasants*, Donald R. Hopkins examines in detail the source and course of smallpox and the efforts to control and eradicate it over time. Hopkins is especially adept at surveying, not only the historical influence of smallpox throughout the world, but also the progression of the disease and the efforts to contain and conquer it in the span of the history of the United States. He, like Fenn, chronicles the concern of George Washington about the vulnerability of his army around Boston in 1775 as a smallpox epidemic raged within the city, and his suspicions that the British might have sent infected civilians into his lines. Unlike Fenn, whose narrative ends with the epidemic in 1782, Hopkins illustrates how a smallpox-stricken Abraham Lincoln, never vaccinated like many of his countrymen and women, diagnosed as such within days after his immortal Gettysburg
Address in 1863, nevertheless survived his relatively mild bout and perhaps avoided a
totally different outcome to the American Civil War. 12

Jonathan Tucker’s *Scourge: The Once and future Threat of Smallpox*, deals
dramatically with the recent history of smallpox control and the seemingly successful
attempt at eradicating the disease in 1980. The word “seemingly” is emphasized because,
as Tucker explains, there is evidence that the former Soviet Union, which controlled half
of the world’s remaining stock of smallpox virus, sought to create a weaponized strain of
smallpox that would 1) survive and infect even if delivered as part of a nuclear bomb
payload, 2) increase and enhance the lethality of the Variola major strain, and 3) combine
smallpox with other pathogenic viruses to create a virtually invincible biological weapon.
According to Tucker, the United States was concurrently feeding the Soviet Union
disinformation that it too was engaged in a biotechnical race -- indeed the ultimate irony.
13 The point of Tucker’s work is that with the fall of the Soviet Union, some of this
research, if not actual samples, may have fallen into the hands of would-be terrorists.

Smallpox itself has never generated too much controversy, only death and misery.
Like many other contagious diseases, such as measles, mumps, cholera, influenza and a
host of others, it was accepted as just another one of the plagues that afflicted mankind.
While the origins of the disease remain veiled in the distant past, some scientists and
historians trace its roots from domesticated animals, just as the less virulent cow pox may
have made the transition to humans. Others believe it may have originated among contact
with animals in the wild, such as monkey pox, which has affected some peoples and
tribes in Central Africa today. 14
Whatever its origin, two important facts seem to be true: Smallpox needed a population concentration before it could become a threat to people around the world. The disease may have shown up among individuals, and in early tribal areas or isolated city states sporadically for centuries, but there is little or no historical evidence. Second, it may also be true that smallpox, at least in its initial phase, existed in an entirely different form than the one which emerged to ravage mankind. Earliest evidence based on a mummified Egyptian pharaoh indicate the appearance of smallpox as early as 1200 B.C.\textsuperscript{15} Greek, Indian, and Chinese written accounts further reinforce the evidence that smallpox emerged as a major epidemical threat to humans between 900 B.C. and 400 B.C. Once again the writings reinforce the evidence that smallpox needed a large population in order to continue to replicate itself. The virus, which has no animal vector, either kills its victims or leaves survivors scarred and disfigured, albeit with life long immunity.

Whatever its origins, its effect on the nearly discovered Americas was rapid and devastating to the indigenous populations. Long before European settlements had been established and secured, the disease had already decimated the Aztec and Inca empires of Mexico and Peru.\textsuperscript{16} When the Pilgrims first made landfall in present day Massachusetts in 1620, they found an abandoned Native American village, its inhabitants decimated, almost certainly by smallpox.\textsuperscript{17}

As Table 1 on the next page illustrates, the symptoms of the disease follow a predictable pattern.\textsuperscript{18} For many native peoples of the Americas however, and later in other more isolated worldly locales, smallpox often struck in its most virulent forms.
Table 1. Smallpox: communicability, symptoms, and pathogenesis

<table>
<thead>
<tr>
<th>COMMUNICABILITY</th>
<th>DAY</th>
<th>SYMPTOMS &amp; PATHOGENESIS</th>
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</thead>
<tbody>
<tr>
<td>not contagious</td>
<td>1</td>
<td>no symptoms</td>
</tr>
<tr>
<td></td>
<td>2</td>
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<td>11</td>
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<tr>
<td></td>
<td>12</td>
<td>first symptoms</td>
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<tr>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>contagious</td>
<td>14</td>
<td>Fever, backache,</td>
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<tr>
<td></td>
<td></td>
<td>headache, nausea,</td>
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<tr>
<td></td>
<td>15</td>
<td>Macules</td>
</tr>
<tr>
<td>very contagious</td>
<td>16</td>
<td>Papules</td>
</tr>
<tr>
<td></td>
<td>17</td>
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<tr>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>contagious</td>
<td>21</td>
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<td></td>
<td>22</td>
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<td>25</td>
<td></td>
</tr>
<tr>
<td>scabs contagious</td>
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<td>30</td>
<td></td>
</tr>
<tr>
<td>not contagious</td>
<td>31</td>
<td>Scars</td>
</tr>
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</tr>
</tbody>
</table>
Pustules either ran together (60% mortality rate) or at other times attacked internally causing hemorrhaging from under the skin (90% mortality rate). Europeans generally suffered the symptoms outlined on the chart, suffering a death rate of up to 30%, but as mentioned earlier, many survivors were scarred for life.¹⁹

By the time the American colonies began to grow in area and population, smallpox was just one of many diseases to ravage the growing population. Yet smallpox may have been the most feared because of its high mortality rate and its cyclical nature. While the lack of medical knowledge about the epidemiology of the disease was lacking, officials in the burgeoning American colonies took what precautions they could once an epidemic appeared. Individuals, streets, towns, and even ships with their passengers and crews, were quarantined to restrict the spread of the disease. Another method employed by the colonists was simply to flee the area once smallpox cases appeared. It is interesting to note that on some occasions, those who fled in order to avoid the disease often carried it to the next town or village. However, because people did not understand the susceptibility of smallpox, both quarantine and flight left those who escaped vulnerable to future outbreaks.²⁰

The first medical advisory printed in North America, a “broadside” written by the Reverend Thomas Thacher in Boston in 1677-78, provided residents with a well-defined outline of the symptoms, treatment, and prognosis of the different strains of the disease. This work, entitled, A Brief Rule To Guide The Common-People Of New-England How To Order Themselves And Theirs In The Small Pocks, Or Measles, and based on a work by the English physician, Thomas Sydenham, was the most informative and accurate
work of its time. Indeed, it was reprinted again during the epidemics that struck in 1702 and 1720.\textsuperscript{21}

Yet by the latter date, as another horrific smallpox epidemic descended upon Boston, a possible solution to the disease for Europe and the Americas made its appearance in England and in the American colonies almost simultaneously. Although known and used in parts of Asia and Africa to treat smallpox for centuries, the advent of inoculation in colonial America would not be the cure-all that it should have been.

Inoculation During the Colonial Era 1721-1781

As John Duffy has documented in his seminal work, *Epidemics in Colonial America*, major port cities such as Boston, New York, and Philadelphia suffered repeated visitations of smallpox and other major devastating diseases through the seventeenth and eighteenth century. However, he alone seems to attribute the fact that these episodes were, in fact, cyclical rather than endemic as they were in most large contemporary English cities and towns due to the better overall health and standard of living of the general population in Colonial America.\textsuperscript{22}

The year 1721 proved a momentous one in the battle against smallpox in colonial America. A terrible epidemic swept through Boston, killing its victims at a rate of over 100 per 1000 of the population, nearly twice the mortality rate of previous smallpox epidemics that had hit the city.\textsuperscript{23}

The Reverend Cotton Mather, pastor of North Church in Boston, realized that something must be done this time to alleviate the horror of this particularly virulent
epidemic. He had been aware for some time, through contacts in England as well as from his own African slave, that through inoculation, a less serious form of the disease usually developed. The procedure, known in parts of Asia and Africa for centuries varied, but usually involved deliberately infecting a healthy patient with smallpox through an incision. In parts of Asia, the process involved inhaling the particles of a ground up smallpox scab through the nose. In an abbreviated incubation period, the patient usually developed a much milder form of smallpox, which usually resulted in much less scarring, reduced overall symptoms, and a lower fatality rate compared to the usual victim who acquired the disease naturally. Most importantly, those inoculated were, like those who survived a bout of smallpox, immune from the disease for the rest of their lives.

Although Mather was not aware of it, at virtually the same time, Lady Mary Montague, the wife of the English ambassador to Turkey and a smallpox survivor herself, had had her son inoculated successfully. She had been convinced of the efficacy of inoculation from her observations while in Turkey with her husband. She gained the assent of the English royal family, to whom she was close, to also be inoculated, although only after the procedure had been successfully carried out on prisoners and pauper children.

When Mather appealed to the local doctors to try inoculation in smallpox-ravaged Boston, he was soundly rebuffed by nearly every physician. The medical community had not heard of the procedure and most were appalled by the idea of deliberately infecting a person with a disease that produced a death rate of 30% to 80% and virtually permanent disfigurement if one survived. Only one of Boston’s ten physicians responded positively
to his call: Dr. Zabdiel Boylston became the lone physician willing to try it. He did so, on
his son and two of his household slaves.\textsuperscript{27}

As soon as his action became known, there were violent protests by other
physicians, ministers, and citizens. Boylston was forced to barricade himself and his
family in his home for protection. Mather himself had a firebomb that failed to explode
hurled through his window with a note attached that read in part: “Damn you! I’ll
inoculate you with this and a pox to you.”\textsuperscript{28}

The immediate controversy of inoculation was not surprising. In an age when the
art of medicine still revolved around treating body humors that dated back almost 1500
years, very few doctors were willing to try any new treatment. Most medical practitioners
still believed the Hippocratic school that disease was the result of imbalances of four
basic humores: blood, yellow bile, black bile, and mucous. However, the debate over
inoculation as a way to treat smallpox had other roots as well. The opposition in Boston
against Cotton Mather’s proposal had much to do with the struggle between religious and
secular matters. Donald R. Hopkins in \textit{The Greatest Killer} delves into this area in some
detail. One of Mather’s detractors was Dr. William Douglas. While Mather’s writings
indicated that he believed smallpox was caused by minute, living particulars that found
their way into the pores of the skin (the animaliculae theory), Douglas believed smallpox
was a contagious disease spread by human to human contact. In this regard, Douglas’
theory was correct, and Mather’s was not.\textsuperscript{29}

On the other hand, Mather’s belief that inoculation could lessen the severity and
morbidity rate among smallpox victims was, in the long term, a better solution than that
espoused by Dr. Douglas, who opposed inoculation on the grounds that it was unproven and could pose the threat of spreading the disease more widely. The debate over how to treat smallpox, then, became a battle between religious and secular influence unique to New England.

The issue raised by Dr. Douglas that those inoculated might spread the disease was not at all unfounded. Between its advent in 1721 and the early 1760s, those who underwent inoculation were under greater risk to themselves as well as potentially to those who had not had smallpox. Patients like John Adams, the future second President of the United States, faced a preparatory diet of mostly mercury and milk for a week or two before the inoculation. In addition, those inoculated in this period received their inoculation from a deep incision made in current smallpox victims and transferred to a deep incision in their arm. While most who were inoculated in this manner suffered fewer acute symptoms as well as fewer pustules and scars than those not treated, they also often did not remain isolated during their infectious stage, thus endangering others in the community.

When John Adam’s wife Abigail was inoculated twelve years later in 1776, some of the medical procedural threats had been mitigated, thanks in part to Robert Sutton in England. Most of the preparatory dieting had been eliminated, smaller incisions from others who had been inoculated rather than smallpox patients themselves were used, and the patients were encouraged to isolate themselves from the general population. The last point was not always followed; Abigail Adams regularly attended church services while contagious. Inoculees did infect others while contagious and some of the inoculees as
well as those they infected died, although at a rate of about one percent, as opposed to the fifteen percent to thirty percent who usually succumbed to the illness. However, in response to the indifference those inoculated often exhibited during their quarantine, restrictive laws were passed throughout the colonies to ban inoculation, or at least limit it except in times of epidemics. Such laws extended from Norfolk, Virginia to Marblehead, Massachusetts.  

The economic impact of inoculation often affected who could take part. Few doctors offered the service and of those who did, nearly all charged a fee. As a result, prospective patients often had to be away from home and/or their place of work for up to a month. This limited the treatment to the wealthy who could afford both. Some attempts were made, especially during epidemics, to include those who ordinarily could not afford inoculation, but for the most part, when a smallpox epidemic swept through a town or region in colonial America, the victims were typically the poor and the very young.  

As the American anger toward British colonial rule increased in the early 1770s, the issue of smallpox inoculation took on a whole new perspective. Once the revolution began, the whole question of inoculation became a wartime concern, especially for the American rebels. While smallpox did not determine the outcome of the war, the use of inoculation helped shape the course of the struggle. Through Elizabeth Fenn’s *Pox Americana*, we now know that the entire American Revolution was fought at the same time a major smallpox epidemic swept throughout North America. Her detailed and extensive account of its effects on both sides of the conflict provides an in depth analysis of the role of smallpox in wartime. By melding the
interaction between biology and the historical account of warfare, Fenn demonstrates the dynamics and impact of infectious diseases like smallpox.

Thus, the initial success at Lexington and Concord by the local militias over the British regulars was almost immediately overshadowed by the specter of smallpox. The British had retreated to Boston, then in the grip of a smallpox epidemic. The American troops surrounding the city could not attack, in part because many of the diverse units from the New England countryside either had never had smallpox nor been inoculated against the disease, while most of the British forces within the city were either smallpox survivors or inoculees. George Washington, who assumed command of all rebel forces in July of 1775, could not afford to send the vulnerable militias into Boston.

Correspondence with Congress indicated that Washington feared the British might take advantage of his troops’ vulnerability and seek some way or method to infect his men. Only after the British evacuated the city in March of 1776 did Washington, himself a smallpox survivor, send in troops, but only men who were not in danger of being brought down by the disease. Inoculations would have enabled Washington to take a possible offensive action earlier, but wholesale inoculation would have incapacitated a large part of his forces in the area for at least a month, and piecemeal inoculations would have taken much too long. By quarantining anyone attempting to leave Boston during the siege, Washington postponed, but did not solve, the inoculation dilemma facing his army. Events in the north and south would tragically demonstrate what smallpox could do to unprotected forces on both sides.
A recent article by Ann Becker in the *Journal of Military History* examines in great detail how the American campaign into Canada in 1775-76 shaped Washington’s strategy in dealing with smallpox and the army. Becker agrees with Fenn that not only did the threat of smallpox hamper combat effectiveness and recruitment, but also raised the specter of biological warfare. Washington was aware at the siege of Boston and became aware as the battle and siege near Quebec progressed, that the British use of inoculated sympathizers and civilians to infiltrate the largely vulnerable American lines was no idle threat.\(^{39}\)

In an article that appeared in *The Journal of American Historian*, Elizabeth A. Fenn views what we would call biological warfare as more common at that time than previously thought.\(^{40}\) She examines the case of General Jeffery Amherst who has been accused by many of deliberately providing smallpox infected blankets to Native American adversaries during a parley near Fort Pitt during Pontiac’s Rebellion in 1763. She indicates that others did the deed, but that Amherst approved of it and other subsequent uses of smallpox-infested clothing. She also cites instances, from the siege of Boston in the Revolutionary War’s earliest days to the Battle of Yorktown in 1781, where George Washington and his subordinates suspected that the British intentionally sent naturally infected and newly inoculated civilians into the American ranks to spread smallpox among the troops.

Apparently, as Fenn observes in her article, “In conflicts with ‘heathen’ Indians, European rules of war gave license to unfettered violence, complete annihilation, and, yes, biological warfare.”\(^{41}\) A British military text published in New York in 1777 made
reference to inoculating the American rebels with smallpox-tipped arrows. However, in later editions, this reference was deleted. Fenn surmises that the British high command might have reasoned that such statements would hardly win the minds and hearts of their American cousins, and might also appear morally reprehensible to everyone involved in the conflict.\textsuperscript{42}

Thus, in November of 1775, two American armies sought to conquer Canada and deprive the British of northern bases that threatened New England. The eleven hundred man force, about half of whom had been detached from the siege at Boston, took Montreal, and pushed on to their primary objective, Quebec City. Unfortunately, the Americans were exhausted, starved, and stressed from their drive northward. In addition, once again there was a diverse mixture of militia in close quarters, many whom had never experienced smallpox. To further complicate matters, many of the New England troops’ enlistments would expire on January 1, 1776. As mentioned earlier, smallpox broke out among the Americans. Generals Benedict Arnold and Richard Montgomery, attempted to quarantine the sick from the healthy in hospitals, but many of the stricken refused to obey the command to do so, and thus spread the contagion. Confronted with fewer and fewer able-bodied troops and the enlisted deadline, the Americans attacked Quebec City in a snowstorm on December 31, 1775. They were defeated, and over 400 men captured.\textsuperscript{43}

While the survivors continued to lay siege to Quebec City, smallpox continued to ravage their ranks. Within Quebec City, the British isolated and quarantined the enlisted men from the officers. The former continued to suffer from smallpox; the latter requested to be inoculated and were allowed to do so.\textsuperscript{44}
American forces outside Quebec City continued to be reinforced through the winter and spring of 1776, but many of the arriving troops were susceptible to smallpox and were put out of action. At one point, there were over 1900 soldiers besieging the city, but nearly half were hospitalized with smallpox or other debilitating illnesses. British reinforcements arrived in May of 1776, attacked the weakened rebel forces and drove them into a headlong retreat, leaving behind, “guns, supplies, and the sick.”

What limited quarantine system had been in place disintegrated as the Americans fled. Although ordered not to do so, soldiers began to inoculate themselves and their comrades, hoping to become infected with the less virulent natural disease as the smallpox continued to ravage their fleeing army. In the end, the British reinforcements drove the sickened American forces from Canadian soil. When the results of this stunning defeat by the British and “General Variola” reached Philadelphia, the Continental Congress, at the request of its Medical Committee chaired by Dr. Benjamin Rush, authorized the systematic smallpox inoculation of the army.

This task, however, proved more formidable at times than the enemy itself. Washington had to contend with the temporary loss of large numbers of troops due to inoculation and recovery time. Fenn to some degree, and Becker in more detail, examine the nearly year-long struggle facing Washington to put this strategy into place to save his army. The results were successful by 1778, and Washington’s correspondence to his commanders and the Congress reflects less concern about the specter of smallpox as a threat to the army.
Once again in *Pox Americana*, Elizabeth A. Fenn devotes much detail to the following episode that affected mostly African-American slaves and some white indentured servants who looked to gain their freedom by rallying to the British cause. Unfortunately, from a health viewpoint, few, if any, had ever had smallpox or been inoculated against it. When combined with the close quarters of military life and the generally unsanitary conditions of the day, the end results were not totally unexpected.49

In Washington’s own Virginia, another American force-- one allied with the British-- would encounter its own smallpox debacle. There, the royal governor, John Murray, known as Lord Dunsmore, proclaimed in November of 1775 that all indentured servants, Negroes, and others who were willing to bear arms for His Majesty would be free. Many, including one of Washington’s painters, a white man, joined the Loyalist force raised by the governor. Among slaves, the number that became a part of Lord Dunsmore’s Ethiopian Regiment was said to be between 800 and 1000. This unit saw only sporadic action, suffering a defeat near Norfolk in early December of 1775. Despite the setback, the regiment continued to grow, but at the same time it also became more susceptible to the threat of smallpox.

The regiment spent the next two months on barges along the Chesapeake Bay coastline, launching attacks against rebel positions. The unit continued to attract slaves and indentured servants, as well as the threat of disease, especially smallpox. By early 1776, the contagion struck. The segregated regiment landed near Portsmouth, Virginia, in February of 1776, where the decision was made not to inoculate because too many troops would be incapacitated for too long a time. Instead the regiment landed at Gwynn’s
Island, at the mouth of the Plankatank River near Portsmouth, Virginia. Though reinforcements and new recruits arrived daily, the smallpox spread, debilitating and killing them almost as rapidly as they came. When the island was abandoned in July of 1776, the rebel forces who retook it found only dead and dying men and over 500 graves. The disease remained endemic in the region for over a year.

With the specter of smallpox hanging over the rebel, and occasionally loyal, forces, why was inoculation delayed so long? The lack of medical knowledge about the epidemiology of the disease; the lack of or, in some cases, outright defiance of quarantine during inoculation; and the overcrowding of susceptible men contributed to the terrible casualties. However, within fifteen years of the Revolutionary War’s end in 1781, the introduction of the smallpox vaccine seemed to promise an end to this deadly scourge.

The Role of Smallpox Vaccination in the Nineteenth Century

The advent of vaccination, as mastered by Dr. Edward Jenner in 1796 in England, changed the dynamics by which smallpox could be brought under control. Jenner, an English country doctor, noticed that milkmaids did not suffer from smallpox, but contracted the much less virulent cowpox from cows. Those vaccinated also did not contract smallpox, so there was no danger of infecting or spreading the disease to others. In addition, there were mild side effects, usually a low-grade fever, unlike the more virulent reactions that might occur with inoculees.50

Although it was not understood at the time, the cowpox or horsepox, that Jenner used to vaccinate his patients worked by activating the human body’s immune system
with a variant of the actual disease that offered protection without the risk of the actual disease itself. Unfortunately, while vaccination was safer to administer and certainly offered protection, it was not permanent. Dr. Jenner went to his grave in 1823 believing that it was, but time demonstrated that it was not so. Immunity usually lasted from 7 to 10 years, but those who did contract smallpox after being vaccinated generally suffered from a much less severe form of the disease.

The new vaccine reached the United States in 1799. Dr. Benjamin Waterhouse, one of the earliest professors of medicine at Harvard, had read about Jenner’s discovery. He sent away for some vaccine from England, and actually received a supply that remained active. He vaccinated his family and servants, who became the first to receive this procedure in the country. Controversy later arose when other physicians accused Dr. Waterhouse of refusing to share the vaccine with them while, at the same time, demanding a portion of the profits from those whom he had shared the vaccine. At the same time some of the same arguments that raged against inoculation surfaced against vaccination soon after its introduction. The clergy and the medical establishment generally believed that “... inoculating a healthy person from a diseased animal was repulsive, unsafe, and ungodly.”

Another argument against vaccination claimed that cow pox was actually a type of bovine syphilis. As the drawing illustrates (see Appendix C p.4) a cartoonist also poked fun of the cowpox vaccination, showing people sprouting horns, tails, and other cow-like traits. Misconceptions of this nature were due, once again in large part,
because people in the early nineteenth century simply did not understand the epidemiology of smallpox as well as many other contagions.

One major problem that has still not been adequately explained involved the virus itself and its origin. There were numerous horse and cow infections, only one of which provided any protection against smallpox. In addition it was very difficult to keep the cow pus viable and free of other contaminants such as hepatitis and syphilis. The pus and lymph that contained the live virus from infected cows had to be removed between the fifth and eighth day in order to be effectively used as a vaccine. Because of its susceptibility to high temperatures and exposure to sunlight, it was difficult to keep the virus alive and ship it any great distance.

Yet another early problem involved how the smallpox vaccine was passed from person to person. The earliest involved passing the exposed scab from one person to an open wound in the arm of another, the so called arm-to-arm method. Often, other infections were transmitted in addition to the vaccine. A much safer method was developed in 1843 in Europe by passing the virus from cow to cow. This method reached the United States in 1860, just before the outbreak of the Civil War.

The public as well as the medical field’s lack of knowledge of how the vaccine actually worked coupled with the vaccine’s high incidence of contamination led municipalities throughout the United States to overturn or ignore vaccination statutes at all levels of government. As early as 1811, the United States Congress established the National Vaccine Agency due in part to Thomas Jefferson’s legacy to promote vaccination.
However in 1820, Congress repealed this law in the face of public opposition; the head of the National Vaccine Agency had accidentally forwarded live smallpox virus instead of cow pox to a vaccinator.\textsuperscript{59} In Massachusetts, a state law that required smallpox patients be isolated in special hospitals, was repealed in 1838. As a result, there were 1,491 smallpox deaths in the state between 1839 and 1861; while the law had been in effect between 1811 and 1838, there had been only 52 deaths.\textsuperscript{60}

During the Civil War, both the Union and Confederate forces suffered from the effects of an inconsistent vaccine implementation policy. Southern troops, which still relied on the arm-to-arm method of vaccination, suffered over 5,000 casualties before the battle of Chancellorsville in early May 1863, when, by using the arm-to-arm method, they were contaminated with syphilis.\textsuperscript{61}

Within the Union ranks, black troops suffered a much higher percentage of smallpox cases and deaths than their white counterparts, as they were less likely to have been vaccinated. Statistics indicate that about 2300 black troops died out of about 6700 reported cases, while just over 4700 White Union troops died of the disease out of about 12,000 reported cases. These figures are based on a total of 61,000 black and 430,000 white soldiers who served the North during the course of the Civil War.\textsuperscript{62}

Jonathan B. Tucker reports in his book, \textit{Scourge}, another example of biological warfare in the United States. Although brief and fragmentary, the account of a Southern supporter who sold clothing contaminated with smallpox to unsuspecting Union troops in Kentucky, resulting in the death of at least one officer from the subsequent outbreak, suggests that its use in wartime had not ended with the American Revolutionary War.\textsuperscript{63}
In the latter third of the nineteenth century, scientists began to discover and better understand the epidemiology and causation of many of the diseases that had heretofore plagued the human race. Louis Pasteur’s work in France on the germ theory of disease causation, Robert Koch’s work in Germany identifying bacteria as the causative agents of cholera and tuberculosis, and Dimitry Ivanovsky in Russia advanced theories on the existence of viruses and accelerated the learning curve in mankind’s effort to successfully combat disease in general. Yet in the United States, already armed with the weapon to disarm the scourge of smallpox, the battle did not go well.

As a great wave of immigrants from Europe and elsewhere swept into the country between 1870 and 1910, smallpox cases, especially in eastern gateway ports of entry and major rail hubs began to grow. Fleeing their homelands for religious, political, economic, and social reasons and attracted by the hope and promise of the United States, many new arrivals refused to accept “... more restrictions and abridgements of liberty to secure themselves against that terrific scourge that any absolute monarch would have enforced.” Thus thousands died in major metropolitan cities such as Boston, Philadelphia, Baltimore, Cincinnati, and New York City.

Another variable occurred near the end of the nineteenth century. In 1897, over fifty cases of smallpox broke out in Pensacola, Florida. Perhaps the most remarkable trait about this mini epidemic was that no one died. The patients were not as ill as they would have been in a Variola major attack, and none of them suffered any serious scarring. This marked the advent of Variola minor in the United States, a less severe form of its deadly relative. It is still not clear exactly from where or from whom this strain of
smallpox originated, but it did complicate the attempt to control the more serious form. Because the two types were only distinguishable by their severity, many people began to believe that should they become infected, it would be with the less deadly minor strain, and so refused to be vaccinated. This complicated smallpox eradication and control throughout the country, since both versions of the disease might be present at the same time.\textsuperscript{67} While the number of cases in the United States rose dramatically for a few years after the advent of the less deadly version of smallpox, the overall percentage of deaths attributed to smallpox fell from twenty percent in 1895 to six tenth of one percent by 1906.\textsuperscript{68}

Smallpox Vaccination in the Twentieth Century

With the arrival of Variola minor, the number of the more severe Variola major cases began to decline dramatically at the dawn of the twentieth century. Unfortunately, the number of vaccinated persons also declined as people perceived that smallpox was no longer the threat it once was. Opposition to vaccination and vaccination laws remained rampant. In California, the law to vaccinate children was repealed in 1911. Within eight years, over sixty-five percent of the smallpox cases were among children under the age of fifteen. As late as 1930, four states had laws that prohibited compulsory vaccination, twenty-nine had no vaccination laws at all, and six had local option laws regarding vaccination. A survey taken in 1930 indicated that about forty percent of the country had never been vaccinated. The latter figure seemed to buttress a statement made a few years
earlier in 1925 that claimed the United States had more reported cases of smallpox than any other country in the world except India.\(^6\)

Between 1930 and 1950, smallpox virtually disappeared in the United States. Strict code enforcement certainly played a role, but even in the many states and municipalities that had little or no effective laws to suppress smallpox through vaccination, the number of victims virtually vanished. One possibility advanced to account for this trend included the now widespread use of iceboxes to store the vaccine and thus insure more potent doses. Indeed, smallpox cases fell from about 121,000, in 1921 to between 5,000 and 15,000 by 1939.\(^7\) Whatever the reasons, in the few cases reported in the United States after the mid 1940s, all could be traced to have originated in other countries.

Overseas, smallpox rallied in the carnage and chaos of war. Indeed the disease made its last appearance in an epidemic of sorts in New York City in 1947, when an outbreak led to over 6.3 million vaccinations. Two people died of smallpox; six died from side effects of the vaccine.\(^8\)

While the deaths from vaccination versus the deaths due to smallpox in New York City in 1947 raised concern within the United States Public Health Service, the country continued to vaccinate and revaccinate to keep smallpox cases from abroad infecting the general population. By the early 1960s the Center for Disease Control, now the agency in charge of the vaccine, completed a study that indicated that out of 14 million vaccinated and revaccinated persons, six had died as a result of the vaccine and nine had suffered permanent brain damage. As a result, the CDC recommended that infants under the age
of one year not be vaccinated for smallpox, but urged that school children be vaccinated to maintain herd immunity in case the deadly disease entered the country.\textsuperscript{72}

Yet evidence gathered by the CDC in 1960s through the 1980s indicated that people with compromised or suppressed immune systems, pregnant women, eczema suffers, and AIDS victims were susceptible to conditions known as progressive vaccinia, fetal vaccinia, and generalized vaccinia. The first two were generally fatal to their victims; the third usually had a positive prognosis.\textsuperscript{73}

With smallpox virtually eliminated as a disease in the United States after 1947, and worldwide by 1980, thanks in large part to a global cooperative effort unusual for its time, the world could heave a collective sigh of relief. The vaccine was discontinued in the United States in 1984, the last nation in the world to do so. Military personnel continued to be vaccinated until the early 1990s.\textsuperscript{74} The scourge had been defeated, and the vaccine to keep in check was no longer needed. Or was it?

Contemporary Views on Smallpox

In \textit{Scourge}, Jonathan B. Tucker examines the global effort to exterminate smallpox from the earth and what might have gone wrong with the attempt to do so. Led by the United States and the Soviet Union under the auspices of the United Nation’s World Health Organization, (WHO), smallpox was eradicated as a world-wide menace
by 1980. Tucker’s account is perhaps the best of a small handful of books that has
examined this milestone in medical history.

At the same time, Tucker also shares insights in the progression of smallpox and
the development of vaccination policies by states and the federal government in the
nineteenth and twentieth centuries. He also states that the actual vaccine in use, from the
late 1930s, is not the cow pox virus first used by Edward Jenner nearly 150 years before.
This genetically distinct orthopoxvirus origin, known today as vaccinia, is a mystery.
Some theories suggest it is a variation or combination of the original vaccine, or not even
cow pox at all but rather a form of horse pox widely used as a vaccine in the nineteenth
century, but since extinct in nature.\textsuperscript{75}

However, the most disturbing part of Tucker’s work deals with the fate of the
world’s last samples of smallpox virus. By an agreement among the nations of the world,
only two countries, the United States and the Soviet Union, would retain specimens in a
secure environment after 1984. The purpose of preserving these relatively minute
amounts were for potential genetic study and possibly vaccine development. These stocks
were to be destroyed by the end of 1999. They still exist.

In 1993 a leading scientist from Russia, Kanatjan Alibekov, defected to the
United States. A thorough debriefing revealed that the Soviet, and later Russian
governments, had used the smallpox stockpile in their possession to design bioterror
weapons to be used against the United States and its allies in the event of a major
conflict. It is one of the great ironies of the Cold War era that the Russians were led to
believe American disinformation that the United States too was engaged in illicit
biowarfare weapons development. The scientist reported that the Russians had made a number of advances using the smallpox materials in their possession as well as in tandem with other biological, chemical, and nuclear materials.\textsuperscript{76}

Alibekov reported that the smallpox cultures had been undergoing biological enhancement at two other sites in the then Soviet Union and had not been simply restricted to the official WHO repository in Moscow. In addition, he could not rule out the possibility that some of the smallpox virus that he had helped develop into weapons grade material had not been removed from the country when the Soviet Union collapsed.\textsuperscript{77}

Even before this startling event, those who were torn over the impending possible elimination of the United States’ supply had taken sides in the debate. On one side were the “Destructionalists,” those who favored the elimination of any smallpox reservoirs anywhere. Their arguments centered around the fact that because the DNA sequence had been decoded, the live virus was no longer necessary to identify any future outbreak of the disease. Furthermore, because the disease was a people-only contagion and had been eradicated, there was no need for further clinical studies. Finally, retention of stockpiles in Moscow and Atlanta might encourage terror groups or even “rogue” nations to steal or develop the smallpox on their own. Destruction of these last remaining stocks would also send a message that any attempt to develop or secure smallpox would be treated as an international crime.

“Retentionists” argued that the two remaining stocks should be retained in the event that either some related virus, such as monkey pox, might someday mutate into a
virulent contagious form, or some actual smallpox virus might yet be uncovered in perhaps corpses encased in permafrost. They also suggest that continual study of the virus might yield important insights into how the human immune system works. Another argument implied that should the virus be destroyed, nations might let their stocks of vaccine dwindle away. Finally, “Retentionists” countered that the destruction of the remaining virus would hardly deter any nation or terrorist group bent on the use of a bioterror weapon.78

The “Retentionists” would seem to have the upper hand, their arguments strengthened by the World Trade Center attack on September 11, 2001, the anthrax letters that killed six people October 2001, and the earlier 1995 sarin nerve gas attack in Tokyo, Japan, that killed twelve people and injured more than a thousand. The latter two events seem to reinforce the belief that the potential threat of smallpox as a disease still looms before the world.

Yet what of the vaccine itself? Most nations depleted their stocks by 1980, or in some cases before, as smallpox in its natural state was eradicated. Some nations still retain some freeze-dried vaccine, but there are questions about its shelf life and potency, since such stocks are over 30 years old. Since September 11, 2001, with the possibility that smallpox might reemerge as a bioterror weapon, the United States has begun rebuilding its vaccine stockpile. New questions, however, have arisen over its possible use in the event of an outbreak.

The last great smallpox epidemic might have taken place in New York City in 1947, but quick diagnosis, support among all agencies involved at the local, state, and
federal level, and public cooperation, limited the outbreak to only two deaths. The six deaths from the vaccine perhaps foreshadowed what might occur today. Superstition, religion, and medicinal ignorance are no longer the impediments to timely care experienced by civilian and military figures in colonial America. Better nutrition, health care and services, communication, transportation, and public awareness in the developed nations give those potential victims of a smallpox attack a decided edge in prompt treatment. The vaccine itself may be the problem.

Those vaccinated in New York City in 1947, about 6.3 million, were never checked to see if the medication actually worked, although most were re-vaccinees. Today the medical establishment is well aware that people with weakened or suppressed immune systems are at much greater risk from complications, and this should be considered if and when someone may need to be vaccinated. Since no one in the United States, except some military personnel, has been vaccinated since 1984, this represents a sizable portion of the country’s population.

Smallpox, the disease, may not be dead after all. The potential threat it poses nationwide as well as worldwide cannot be overlooked. Should stolen or hidden supplies of smallpox still be accessible, a fanatical nation or group of terrorists with the time, technology, and resources may have the ultimate non-nuclear weapon of mass destruction. Even with the increased response by nations throughout the planet to the more sophisticated and deadly international acts of terror, one successful attack could kill and maim millions, disrupt world trade, and destabilize governments.
In a secret test conducted in the 1960s, the U.S. Army secretly simulated the release of airborne smallpox with aerosol containers concealed in briefcases at a major airport. At the time U.S. military had an active biological weapons program. An analysis of this exercise indicated that about one in twelve passengers who passed through the airport on that day would have been infected with the virus.\textsuperscript{80} Those infected would not have displayed any symptoms whatsoever for seven to seventeen days, during which time they would embarked to destinations near and far around the country and the world. This occurred at a point in time when many Americans were still protected by the vaccine.

How about the vaccine itself? A recent CDC statement assures the American people that smallpox is manageable should it strike the country, and that supplies of vaccine are available for all who wish to be inoculated should the need arise. It even assures those who may fear receiving the vaccine that they may choose no to do so, even if they have been exposed to smallpox.\textsuperscript{81} The war against smallpox may not be over. Terror, treachery, and technology may yet turn what was thought to be an eradicated scourge into a nightmare from the past.
LESSON PLANS

Introduction

_In Smallpox: To Inoculate or Vaccinate: That Has Always Been the Question_, I hope to have fifth grade students examine in general the origin, devastation, and eventual eradication of one of the major diseases that ever ravaged mankind. Specifically, I want these students to look at the controversy generated within colonial America and later the United States with inoculation, then vaccination, as a way to combat smallpox. The lessons follow a linear progression of the efforts of both physicians and their patients to grapple with a scourge that only revealed its viral origins less than seventy-five years ago. Yet even as ancient cures came to light in Europe and colonial America in the early eighteenth century, the resistance to inoculation and later, vaccination, provide a fascinating portrayal of human opposition based on social, economic, political, religious, and medical grounds.

Through the study and analysis of photographs, art, maps, and primary sources and documents, students will learn about the epidemiology of the disease itself, and the efforts to contain it throughout the world as well as here in the United States in particular.

With Edward Jenner’s discovery of the cow pox vaccine in 1796, students trace the cure in the newly-created United States with its burgeoning expansion, where and when many people refused to be vaccinated as this deadly disease continued to decimate both native and newly arrived immigrants.
Finally, students will examine the success by the middle of the twentieth century of a combination of education, medical advancements, better hygiene, and a fortuitous mutation that enabled smallpox to be the first disease to be wiped out worldwide. Students will also examine and perhaps debate the possibilities of some batches of smallpox which may actually be in the hands of terrorists and what this might mean, potentially to an unvaccinated world today.

Day 1: The “hook” for the series of lessons this week on smallpox is introduced today. Called “A Pox on You,” it is designed to focus and attract the students’ attention. They will also keep a journal each day of relevant vocabulary words and answers posed in class about the content material from the short daily lecture which today will be historical background about smallpox as a disease.

Day 2: Students write down and define the listed vocabulary in their journals. Today’s lecture deals with the advent of inoculation in the early colonies and how people reacted and dealt with it, especially in and around Boston. At the end of the lecture students will examine a map the shows the extent of smallpox throughout the thirteen colonies from the beginning of the seventeenth to the end of the eighteenth centuries. They will then answer a few questions based on the map, and then complete defining any words not already done so in their journals.

Day 3: Students view a video about a family in Williamsburg, Virginia, wrestling with the idea of whether it is the best course of action to have all them inoculated or take their chances as a smallpox epidemic rages in nearby Norfolk. The mother and father try to convince one another of the soundness of their diametrically opposed ideas. The video
ends with no decision made one way or another. Students take sides and argue for or against inoculation, both verbally in class as well as in their journals. Then at the computer lab, they access a related interactive web site where they become a family making the same sort of decision after listening to the advise from friends, family, neighbors, and the local physician. The program shows them what would happen to them, based on their choices.

Day 4: Students write down the selected vocabulary words and define them in their journals. Today’s lecture gives the background of smallpox vaccination and its advantages and shortcomings in fighting smallpox throughout the nineteenth century. At the end of the lecture, students examine a primary artwork etching that pokes fun at the new treatment of smallpox. The students share their observations about the etching and then respond to a series of questions both verbally and/or in written form in their journals.

Next, students examine a primary document from the early nineteenth century that lists what a patient should and should not do after being vaccinated. Students respond once again verbally in class discussion and in written form in their journal. Finally, students examine a map that shows the spread of Variola minor from 1896-1899 across the United States. They compare it with the spread of Variola major from the earlier map and theorize why the spread of the Variola minor was so rapid.

Day 5: Students write and define the selected vocabulary words from today’s lecture notes in their journals. Today’s lecture deals with the decline and eventual eradication of smallpox in the United States as well as worldwide. At the end of the lecture students view a color-enhanced photo of a smallpox virus and answer questions
about it. Then student access an interactive web site that demonstrates how, until recently, the smallpox vaccine was made from infected cows. They then answer selected questions in their journals.

Day 6: Students enter and define italicized words from today’s lecture in their journals. At the end of the lecture, students verbally, and then in their journals, summarize the problems with first inoculation and then vaccination in the colonies and later in the United States. They need to be certain that all vocabulary words have been clearly defined and all questions from the lectures and sources have been answered as thoroughly as possible. There will be a test on these tomorrow.

Day 7: Students take examination on the six previous days’ material. The first part consists of fill in the blanks, where students pick from a list of choices which is larger than the number of fill-ins. Next the students have a series of multiple choice questions to answer. Finally they have two short answer questions, requiring about three to five sentences each to explain. As an alternative assessment students can receive grade based on a presentation in front of the class where he/she is a doctor in colonial times explaining to a patient how a person is inoculated and what is the benefit and the possible risks involved. Then the student would do a second presentation as a contemporary doctor explaining to a patient how the smallpox vaccine is administered, and the benefits and the possible risks involved.
Prior Content Knowledge and Content

Students at the fifth grade level still only have a cursory knowledge of the world in general, historical events, and any sort of major understanding of the nature and force of smallpox in the historic context of the world, but particularly in American history, I plan to use background lectures, visuals, primary source documents, maps, and accounts of the devastating effects of the disease. Using dolls to demonstrate hoe inoculations and later, vaccinations were performed may help the students grasp what people did and have done to protect, or not to protect, themselves against smallpox. At the same time it is also important for students, if only superficially, to understand what causes diseases and how they can be spread. Again, a look and a word about viruses would clarify how this contagion was so deadly.

To help students comprehend how smallpox spread among the colonial population and later, among native-born settlers and, in turn, newly-arrived immigrants, I will use maps and/or overlays to reinforce the geographic component students are just beginning to comprehend. They will also examine primary source documents, paintings, and photographs that graphically portray the misery and pain that smallpox inflicted among its victims and, to some degree, the anguish and fear the promise of inoculation and vaccination posed for those who had not yet contracted the disease. The students use skills acquired in reading and language arts to analyze, synthesize, and evaluate these sources in order to draw realistic conclusions about the disease and its possible cures.
Discussion of Content Hook

My hook will be the simple statement, “A pox on you!” Many fifth grade students will find this sentence puzzling. Most have never heard of smallpox, much less experienced a vaccination to protect themselves from it. To illustrate what it looks like, I will first display a drawing of a body with spots on it, simulating the distribution of the pustules on a human. I will follow this with two photographs of actual smallpox victims, their faces and upper torsos literally jammed with large, painful-looking pustules. I anticipate a shocked and then focused reaction from the students. Now that I have their complete attention and interest, I will go through the incubation, contagious, and course of the disease; how it can spread from person to person, and how for centuries it was probably the world’s greatest killer.

Having further piqued their interest, I will explain that our studies over the next seven days will examine how people in colonial America dealt with this terrible scourge before and after introduction of a “cure,” and why many people could not or would not partake of it. Later we will examine what happened even when a better technique was developed, the disease still remained a public threat, disabling at one juncture, no less a figure than President Abraham Lincoln. Finally the class will learn how smallpox was eradicated in the United States and later worldwide in the last half of the twentieth century, ... but why it may live on as a terrorist threat to a very vulnerable world.
Lesson Content

Day 1: Students will keep a journal in which each day they will write down and define the words which appear in italics in today’s lecture. These words will also appear on the board.

A pox on you! Ask students if they have ever heard this expression before. If so, can anyone tell what it means? (A pox on you was a curse. Someone hoped you would get smallpox, a deadly viral disease that killed millions of people throughout the ages, but was finally declared **eradicated**, or completely eliminated, by 1980.) Smallpox sounds bad. Now, let us look at it. Put a picture on the overhead that shows the drawing of a smallpox, and for comparison, a chicken pox victim (see Appendix C, p.1)\(^3\), with the possible distribution of pox on his body. Follow this with two CDC photographs of actual victims, with inflamed pustules on the head and torso (see Appendix C, pp. 2-3)\(^4\) Discuss how pictures like this bring the words of smallpox’s descriptive symptoms to light.

Lecture: Smallpox was a disease spread from person to person. There was not animal host like malaria or plague. People usually caught it from the droplets released when the *contagious*, patient sneezed or spit, but it could also be caught from the inhaling the crusty remains of a victim’s scabs in the latter part of the diseases cycle.\(^5\) Smallpox symptoms were not obvious until seven to fourteen days after exposure; in fact, during this non contagious period, there were no symptoms at all. Inside the victim, the virus would be *replicating*, or duplicating, itself within the *respiratory tract* (throat and lungs) and later in the *lymph nodes* (the areas in the body where dead disease-fighting white
blood cells are stored until the body can remove them). Sometime between the eighth and fifteenth day, the victim would develop flu-like symptoms, like fever, backache, headache, nausea, and/or listlessness (little strength or desire to do anything). After a day or two, these symptoms go away, and the patient may feel better. However, the fever returns and sores appear in the mouth, throat, and nasal passages. From that point, the patient is contagious.

Now the smallpox pustules, or raised sores filled with pus, as well as a red rash, appear all over the body, with higher concentrations at the extremities (hands, arms, legs, and feet) of the limbs, and particularly around the head and neck. Usually the sores do not run together. If they do, or if the sores have turned into the body, causing internal hemorrhaging, or bleeding, the chances of survival are very small. Even with the generally less serious form of smallpox, other infections may occur, reducing the chances of survival.

To the victim of smallpox, the pustules would feel like fire under the skin and remain so even after the sores have hardened in scabs about two weeks after the first signs of illness. Death, if it happens, would come between the nineteenth and twenty-first day after the first symptoms. After this the threat of death drops dramatically, although long-term disability from the scabs on the soles of the feet and palms of the hands, or even blindness, may have occurred. The victim may also be left with life-long scars from the scabs, which continue to be infectious until they fall off. The entire smallpox cycle, from exposure to recovery, would take about a month. Survivors would have immunity, or protection form a reoccurrence, for life.
Students write and define the specified vocabulary words in their journal. They also write a summary of the smallpox cycle as they recall it. In addition, they write why they believe the saying, “A pox on you,” was a bad curse.

Day 2: Students will keep a journal in which each day they will write and define the words which appear in italics in today’s lecture. These words will also be listed on the board. Can anyone define the word *inoculation*? What might that word have to do with smallpox?

Until 1721 in the American colonies, there was no protection against a smallpox *epidemic* (a widespread outbreak of a disease). Potential victims tried to avoid the disease by fleeing to other non-infected areas, *quarantining* (isolating those suspected of having the disease from the general population), or surviving it which, as we discovered earlier, provides life-long immunity. The best information the colonists had was found in a “*broadside,*” or pamphlet, written by Thomas Thacher in 1678, a minister in Boston, whose description of the symptoms and the *prognosis* (outcome) based on them was quite accurate.

It was in 1721 that another Boston minister, Cotton Mather, proposed a quite daring solution to a severe smallpox epidemic ravaging the city. From information he had learned from one of his slaves as well as correspondence with English doctors in London, Mather proposed that potential victims be inoculated, or infected with the disease by deliberately putting the smallpox into an incision, or cut, in a patient’s hand or arm. Only one doctor of the ten in Boston at the time, Zabdiel Boylston, agreed to do so. He successfully inoculated, or variolated as it was then called, his entire family and others.
While the death rate from naturally occurring smallpox was thirty to sixty percent at this time, it was only one to two percent among those inoculated by Boylston.\textsuperscript{88}

Yet the new inoculation procedure created an uproar. Can you think of some reasons people might oppose it? Many at the time thought it was God’s will that people came down with smallpox and opposed inoculation for that reason. Others opposed it because \textit{inoculees}, (those inoculated against smallpox), who often developed a less severe form of the disease, could nonetheless spread its deadlier form to others while recuperating, or recovering, from the contagion. Still others, especially among the poor, could not afford the time or cost involved since the inoculator had to be paid and the worker had to be quarantined for over four weeks. Finally, Native Americans, who seemed to be especially susceptible to smallpox and other diseases introduced from Europe, suffered a very high rate of death when exposed to it.

Map Activity: Observing the map projected on the overhead labeled, \textit{Smallpox in 17\textsuperscript{th} and 18\textsuperscript{th} Century North America}, answer the following questions in your journal:\textsuperscript{89}

1. Where do most of the smallpox cases appear to occur? (Along the settled eastern seaboard and inland along waterways where towns and villages were located.)
2. If smallpox gives the survivors immunity for life, why did it continue to infect colonists? (Children were born without any natural protection, and newly-arrived colonists continued to arrive. Epidemics occurred among these groups periodically when a large enough population was exposed to the virus).

Students complete defining words in italics from today’s lecture and answer the follow questions in their journal:
1. In your opinion, from what you now know, would it have been better to be inoculated or take the chance that you might avoid the disease altogether, or if you did contract it, survive it? Give arguments to support your answer.

2. Why would colonists in eighteenth century North America oppose inoculation? What were some of the dangers and problems involved?

Day 3: Students will keep a journal in which each day they will write and define the words that appear in italics in today’s lecture. The words will also appear on the board. Activity: Students will view the second half of a video entitled, *Potions, Ails, and Smallpox Tales.*90 This video is available for purchase from the Colonial Williamsburg Foundation, but may already be available in your school, district, or county Instructional Media Center.

The video follows the intense discussion of a family in Williamsburg, Virginia, around 1760. A smallpox epidemic rages not all that far away in Norfolk, and neither the family nor its two slaves have had the disease. The mother, who has lost a brother to smallpox, wants to have everyone in the household undergo the inoculation. The father believes they cannot afford being away from the business for over a month and fears complications from the inoculation might cripple or kill any number of them. By the conclusion of the video, no decision has been reached.

Activity: Students access computers, either in the classroom or in a lab, where they can engage in an interactive assignment based on the video segment recently viewed. In this activity, the students make choices as if they were the family in Williamsburg. Their outcome or fate depends on whose advice the follow in regards to
taking or not taking the inoculation treatment. Upon completing this activity, the students
turn to their journals and answer the following questions:

1. Whose advice did you follow in dealing with the smallpox threat to your family?

2. Based on what happened to you in the simulation, do you think you made the best
   choice for the family? Why or why not?

3. Why do you think that the family you viewed in the video had such a tough
   choice to make of whether to have themselves inoculated?

4. What would you have done? Why?

Day 4: Students will keep a journal in which each day they will write down and
define the words that appear in italics in today’s lecture. These words will also be listed
on the board.

While inoculation provided what seemed to be a tremendous step forward in
holding the scourge of smallpox in check, in was not universally accepted in the colonial
times and later in the United States, as we have seen. It was a dangerous procedure at the
time, with infection and possibly death from unsanitary cutting instruments and poor
health and hygiene (general cleanliness). It continued to be opposed on religious grounds.
It remained out of the financial reach of all but a few, and it killed about one to two
percent of those inoculated.

A major breakthrough was achieved in 1796 when Edward Jenner, a country
doctor in England, proved that by vaccinating, injecting a person with the cow pox, a
relatively mild affliction very similar to smallpox, conferred what he believed at first to
be life-long protection against smallpox. Jenner had learned about the cow pox from
milkmaids who, if infected with it, never did develop smallpox. To prove his hypothesis, Jenner vaccinated a boy with the cow pox, which he developed; then later, infected him with smallpox, which he did not.\textsuperscript{91}

Like inoculation, many did not take to vaccination. One new drawback became apparent after a number of years had passed; the new vaccine did not provide life-long protection against smallpox as Jenner had first thought.\textsuperscript{92} Normal immunity lasted for seven to ten years. Again such dangers as infections, contamination, and religious objections led to opposition and even ridicule of this new technique. It was a cure many in the nineteenth century United States did not want to risk.

At the end of the nineteenth century a remarkable transformation took place with smallpox in America. A new strain appeared in Florida in 1896, probably brought ashore there by sailors or passengers from either South America or Africa. Called Variola minor, to distinguish it from its deadly cousin, this new strain had less severe symptoms and a death rate of less than one percent.\textsuperscript{93} It spread rapidly through North America, among the many who were still unvaccinated, although it killed relatively few, Variola minor’s debut was both good and bad news in the efforts to vaccinate all Americans against smallpox.

Because the new strain was so much less severe and, as time passed, much more common than the deadly Variola major, many of the unvaccinated opted to remain so, believing that should they become infected, it would be with the lesser of the two versions. Unfortunately, especially in urban areas, this was not always the case. As a
result, the number of report cases in the United States rose from about 2000 a year in 1896, to over 20,000 by 1900.94

Activity: Students study an overhead projection of a painting done in 1802 by James Gillray, depicting a group of people supposedly being vaccinated by Edward Jenner himself (see Appendix C, p. 4).95 After viewing the scene carefully, write a description of what you see only. Do not make any judgments about what you have viewed until told to do so.

The next part activity may be done as part of an oral discussion or in written form in the students’ journals:

1. What do you think the painting says about the new vaccination? Does it believe it will succeed? Why or why not? What leads you to this conclusion? (It could be dangerous, unpredictable)

2. What might people fear from the new vaccination? (It might infect them with any disease, it was against God’s will, and it represented an unknown possible outcome.)

3. Would something like this viewed by persons thinking about becoming vaccinated encourage or discourage contagion. (Probably discouragement because recipients are developing animal-like appendages”).

Lesson: Students view an overhead entitled, “Rules to be attended to during the vaccination,” written by Dr. Benjamin Waterhouse, the first doctor to vaccinate people in the newly formed United States. (see Appendix C, p. 5)96 Read the rules that Dr. Waterhouse has listed?
1. Which rules seem to be factual? (Nearly all except #4)

2. Which seem to be an opinion? (Just #4)

3. Do you believe this pamphlet by Dr. Waterhouse will encourage people to try the new vaccination? Why or why not? Finally, students view a map on the overhead projector that shows the rapid spread of Variola across the United States from 1896 to 1899 (see Appendix C, p. 6)

1. Why do you believe the disease spread so rapidly across the nation in such a short time? (Possible responses might include a much better road and rail system in place compared with the earlier progression depicted in the map of the seventeenth and eighteenth centuries and a more mobile population of unvaccinated natives as well as newly-arrived immigrants)

2. Is their anything good about the new strain of smallpox? (Students should speculate after the lecture that a less deadly form of smallpox meant fewer deaths, although the new strain may have hindered already sluggish efforts to vaccinate a reluctant and skeptical public).

Day 5: Students will keep a journal in which each day they write down and define the words that are in italics in today’s lecture. These words will also be listed on the board.

The earlier twentieth century saw a decline in the number of deaths due to smallpox, but no decline at first in the actual number of cases. Despite laws in many, but not all, states that required student to be vaccinated in order to attend public schools, public health officials and parents often ignored them. The newly-arrived Variola minor
seemed less of a threat than vaccination, still bedeviled with problems such as potency (strong enough to provide protection) and contamination as well as many citizens and immigrants opposed to government intrusion into their lives, as they saw it. In California, a mandatory (required) vaccination law for school-age children was repealed (removed) in 1913. By 1919, sixty-five percent of the smallpox cases in the state were among children under the age of fifteen.98

After 1930, however, smallpox cases of both strains throughout the United States declined sharply, although no satisfactory reason has ever been given. A number of factors such as improved public health efforts in hygiene and vaccination, widespread use of refrigeration that kept the vaccine potent longer, and much stricter enforcement of state and federal laws governing childhood vaccinations may have been involved.

In 1947, a smallpox case in New York City mobilized (set into motion) state and federal efforts to vaccinate and revaccinate over 6.3 million people in less than a month of the diagnosis (identification of the disease). As a result, only two victims died of smallpox; six died as a result of complications of the vaccine.99

By 1971, routine smallpox vaccination of children in the United States halted because six to eight children died each year from the vaccine.100 Meanwhile, worldwide, a vast, energetic, and ultimately, successful effort began about the same time. The World Health Organization (WHO) organized and launched a massive immunization effort throughout Africa, Asia, and South America. By 1980, WHO declared that smallpox had been eradicated from the earth.101
Lesson: Students view an overhead projection of a color-enhanced smallpox virus. (see Appendix C, p. 7)

1. Why did it take so long for scientists to finally view the smallpox virus? (Because it is so small, the technology to do so was not available until about 1940).

Lesson: Students access a Public Broadcasting System (PBS) web site called, Killer Diseases on Campus. This includes a section on how certain vaccines have been made. They examine how the smallpox vaccine, one of six listed, was made.

1. What problems would occur when the early vaccines were made without separating impurities in the cow pox? (Other infections would harm the vaccinated person or make the cow pox vaccine less effective).

2. Why do you think this method involving cows is no longer used today? (Advances in technology and more effective an safer procedures are available at the present time.)

Day 6: Students will keep a journal in which each day they will write and define the words in italics in today’s lecture. These words will also be posted on the board.

Inoculation, smallpox, vaccination: they should all be history. Inoculation is, but since the terrorist attack in New York City in September of 2001, the other two may yet still be a part of our lives.

Not all the smallpox virus was destroyed when WHO declared smallpox eliminated. At least two repositories, or secure laboratories, remained. One was in the then Soviet Union, and the other in Atlanta, Georgia. The intent was to have a secure amount available in order to diagnose smallpox were it to reappear at some future date.
The original premise was to destroy the virus in 1995. However, in 1990, the Soviet Union ceased to exist as the monolith (single entity) it once was. In 1992, a defecting Russian scientist, now known by his Americanized name as Ken Alibekov, revealed that rather than simply guard the stored virus, Soviet scientists had experimented and enhanced the deadly virus as well as some biological agents. Upon the collapse of the Soviet Union, not all the scientists and materials involved in their research could be found.

A smallpox attack, even without the enhanced capabilities that may have been added, would have a devastating effect on a virtually defenseless public here in the United States and, indeed, worldwide. Yet mass vaccinations might create its own crisis because people with auto immune deficiencies (weakened immune systems) would be at risk for serious to deadly side effects of the smallpox vaccine. Thus one disease, perhaps the greatest killer of mankind, may still pose a threat. Perhaps even more ominously, its main preventative, a vaccine whose origin dates back well over a hundred years, may be as big a health risk to some as the disease itself.

Activity: Using an overhead of a graph released by the Harvard School of Public Health (see Appendix C, page 8), students study the results of what about 90% of those surveyed would do if a vaccine were available but no smallpox was present, and if the vaccine were present and smallpox were reported in their community.

1. What doesn’t this graph about smallpox vaccination tell you? (It doesn’t tell how many Americans were polled, nor if it were a sample of the whole country or just one particular region.)
2. If there were enough vaccine available, as the top bar graph indicates, what is surprising about the results? (About one out of three people of those polled would not get vaccinated. We can guess that some reasons might be that some believe there really is no threat, or that the vaccine might cause reactions, especially among those with immune deficiencies).

3. If smallpox did break out in a community, why don’t you think everyone would want to be vaccinated? (Lead the students through the summation below)

For various reasons, Americans seem to have been hesitant over embracing a way to stop even a scourge like smallpox. Certainly, in the seventeenth and eighteenth century, religious beliefs that it was God’s will or punishment for a communities’ or individual’s sins probably played a role. Ignorance about smallpox itself and the poor medical hygiene practiced by doctors and the public alike further fueled anxieties. Doctors also were faced with smallpox and later cow pox fluids that might be contaminated or weakened and diluted by heat and time. Even the feeling among Americans and, as the country grew, the millions of immigrants who arrived later, that the government: local, state, or national, could not tell them how to protect themselves played a part. Today smallpox exists only as a possible distant threat by terrorists, but it is interesting to note that should an outbreak occur, some would still not be vaccinated for their own, and presumably, their neighbors’ protection, and/or they may fear the cure might actually be worse for them than the disease.

Evaluation: All evaluation materials, including the answer key, are located in Appendix B.
Appendix A
Grade 5 National History Standards

Contents for Historic Thinking Standards for Grades 5 - 12

Standard 2 D. Evidence historical perspectives

Standard 2 G. Draw upon visual, literary ... perspectives

Standard 3 E. Hypothesize the influences of the past

Standard 4 B. Obtain historical data

Standard 5 A. Identify issues and problems in the past

GRADE 5 CALIFORNIA HISTORY - SOCIAL SCIENCE STANDARDS

Standard 5.4 Students understand the political, religious, social, and economic institutions that evolved in the colonial era.

Standard 5.6 Students understand the course and consequences of the Revolutionary War.

Standard 5.6.4 Understand the personal impact and hardships of the war on families...

Standard 5.8 Students trace the colonization, immigration, and settlement patterns of the American people... with emphasis on the role of economic incentives, ...and transportation systems.
Chronological and Spatial Thinking:

- Students explain how the present is connected to the past, identifying both similarities and differences between the two, and how some things change over time and some things stay the same.

- Students judge the significance of the relative location of a place ... and analyze how relative advantages or disadvantages can change over time.

Research, Evidence, and Point of View

- Students differentiate between primary and secondary sources.

- Students pose relevant questions about events they encounter in historical documents, eyewitness accounts, oral histories, letters, diaries, artifacts, ... maps,... artwork...

Historical Interpretation

- Students identify and interpret the multiple causes and effects of historical events.
Appendix B

Exam
I. Fill in the blank or blanks in the sentences, choosing the correct word or words from the list below. (2 x 10 = 20 points)

1. ____________________ gave you a milder form of smallpox, yet still left you contagious to others, but a ____________________, made from cow pox, was not contagious at all.

2. If you survived smallpox, you had life-long ____________________.

3. With smallpox, your body is covered with ____________________ , infected and raised sores filled with pus that are said to feel fiery hot.

4. In the first few days after exposure, a smallpox victim doesn’t show or feel any symptoms, although the virus is ____________________, or duplicating itself inside the body.

5. ____________________ laws are those that are required, while laws that are ____________________, or removed, as some vaccination rules were in the nineteenth and twentieth centuries, kept the disease alive.

6. If a disease like smallpox has been wiped out, it is said to have been ____________________.

7. A ________________, or medical pamphlet by Thomas Thacher was all the accurate medical advice available in colonial America until 1721.

8. One common symptom of smallpox is ____________________, or restlessness just before the eruptions of the pox.

   mandatory pustules eradicated quarantine broadside hemorrhaging
   inoculation listlessness vaccination replicating repealed immunity

II. Multiple Choice: Choose the best answer. Circle your choice. (5 x 4 = 20 points)

1. The smallpox vaccine was first developed by:  A. Pasteur, B. Jenner, C. Thacher, D. Mather
2. The phrase “A pox on you!” was a: A. thank you, B. warning, C. curse, D. request

3. The less deadly form of smallpox was called: A. Variola major, B. chicken pox, C. measles, D. Variola minor

4. Smallpox is a disease spread: A. person-to-person, B. insects, C. pigs, D. chickens

5. In which two countries is the last of the smallpox virus stored: A. France and Germany, B. Russia and India, C. The United States and Japan, D. The United States and Russia.

III. Short Essays: Write at least three to five sentences about each of the following two questions on a separate sheet of paper. Be as clear and as thorough as you can. (2 x 35=70 points)

1. What are some of the reasons Americans have been reluctant to be inoculated or vaccinated against smallpox in the past as well as today? Is the cure worse than the disease? Explain.

2. When Variola minor reached the United States in the late nineteenth century, why might its appearance slow the efforts of public health officials to defeat the deadlier Variola major?

IV. Alternate Assessment: Do both of the following:

You are an apprentice to a doctor in colonial America in the late eighteenth century. You are going to inoculate your first patient against smallpox. Describe how you have prepared the patient for this. Then, using either a life size drawing of a colonial man or woman or a doll, show how you would perform the inoculation and explain what and why you are doing, and what will happen. Be as thorough as possible. Remember, the doctor is watching!

You are a doctor in the America in the early twenty-first century charged with vaccinating health workers against smallpox in the event of a possible terrorist attack. Using a life size drawing of a man or woman or a doll, show how you would administer the vaccine. Be sure to also discuss the possible risks of the cure to your audience before vaccinating. Be as thorough as possible.
Answer Key

I. Fill-ins: 1. inoculation, vaccination; 2. immunity; 3. pustules; 4. replicating;
5. mandatory, repealed; 6. eradicated; 7. broadside; 8. listlessness


III. Short Essays: 1. Suggested answer should include the following items: religious
concerns; economic concerns, especially since many poor in the colonial era could not
afford the time off from work nor the cost of inoculation; medical ignorance; poor
hygiene; contamination; technological shortfalls, like refrigeration to keep the vaccine
potent; auto-immune concerns, individual rights.

2. Suggested answer should include the following items: false sense of security; few
suffered serious symptoms or died; difficulty in distinguishing the two types of smallpox;
individual rights.

IV. In colonial America, be certain you discuss diet, isolation, cool surroundings,
quarantine, possible side effects, including the possibility of death. After all, the incision
you make could lead to an infection.

In today’s world, be certain to mention the vaccine may cause problems if the patient has
an autoimmune deficiency.
Appendix C

Images
Man with smallpox. Public Health Images Library (PHIL0 id# 131. Source: CDC/Barbara Rice
http://www.bt.cdc.gov/agent/smallpox/smallpox-images/smallpox1.htm
Face lesions on boy with smallpox. Public Health Images Library (PHIL) ID#3 Source: CDC/Cheryl Tyron

The Cow Pock-or-the-Wonderful Effects of the New Inoculation!
James Gillray (1757-1815)
Photographic reproduction of an etching appearing in
_Vide--The Publications of ye Anti-Vaccine Society, June 12, 1802
National Library of Medicine Collection_

The smallpox vaccine, originally prepared from the lesions of people infected with cowpox (a much milder disease contracted from cows), made many people fearful--of cow-borne disease, of usurping God's will, of the unknown. This 1802 cartoon shows Edward Jenner, the vaccine's discoverer, administering it, as previous vaccine recipients erupt with cow-like features.

KINE POCK INOCULATION.

Rules to be attended to during the Vaccination.

1. THE diet to be the same as before vaccination.
2. Scratching or rubbing the arm, or shoving up the sleeve should be avoided as much as possible.
3. In case an itching sensation of the vaccinated part should give the patient uneasiness, a little vinegar applied to the part will give immediate relief.
4. No matter to be transferred from the person inoculated to another person. Taking it from another often becomes a snare to individuals, and the source of spurious matter. But even those, who by chance have had the genuine disease in that way, have no certainty of it—and who would wish to have it upon uncertainties?
5. Women, who do house work, should avoid washing and baking on the 7th and 8th days, the usual time for the symptoms.
6. No danger of washing the hands and face in cold water during the disease.
7. Women may without hesitation receive the Kine Pock in all circumstances without exception, at home or travelling by land or water.
8. No danger of vaccinating children at the period of teething.
9. Labouring men and mechanics need not abstain from their customary employment, provided their indisposition does not require it.
10. Children should never be lifted by the arms,* especially when under the inoculation. The arm should not be bound up, nor confined in tight sleeves.

OBSERVATIONS.

1. It occasions no other disease. On the contrary, it has often been known to improve health; and to remedy those diseases, under which the patient before laboured.
2. It leaves behind no blemish, but a blessing;—one of the greatest ever bestowed on man;—a perfect security against the future infection of the small-pox.

N. B. Save the scab for examination. B. WATERHOUSE.

* No prudent person, who is aware of the tenderness of the bone of a young child, would ever lift one by its arm, or lead a child a mile by one arm.

Cambridge, July 3, 1809.

http://www.library.ucla.edu/libraries/biomed/smallpox/kinepockbroadside.gif

Benjamin Waterhouse 1754-1846
A false-color electron micrograph shows the smallpox variola virus. Formerly an epidemic infectious disease that resulted in permanent scarring and often in death, smallpox was eradicated by 1979 through a worldwide program of vaccination. Today only two laboratories in the world keep stocks of the virus, for research purposes and to make new vaccine should the need for it ever arise again.

Figure 1

Americans Who Would Get Smallpox Vaccination as Precaution Against Terrorist Attack

Vaccine may produce serious side effects in a small number of cases

If vaccine made available

- 59%
- 33%

If cases of smallpox reported in community

- 81%
- 9%

Source: Harvard School of Public Health/Robert Wood Johnson Foundation Survey Project on Americans’ Response to Biological Terrorism, May 2002

http://www.hsph.harvard.edu/press/releases/smallpox/smallpox1.gif
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Hopkins, *The Greatest Killer*, 88
Tucker, *Scourge*, 28-29
Hopkins, *The Greatest Killer*, 88
Hopkins, *The Greatest Killer*, 267
Hopkins, *The Greatest Killer*, 268
Tucker, *Scourge*, 32
Hopkins, *The Greatest Killer*, 75
Tucker, *Scourge*, 32
Tucker, *Scourge*, 34
Hopkins, *The Greatest Killer*, 282
Hopkins, *The Greatest Killer*, 283
Hopkins, *The Greatest Killer*, 290
Hopkins, *The Greatest Killer*, 291
Tucker, *Scourge*, 35-36
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Tucker, *Scourge*, 51
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