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## **Toxic, Persistent Chemicals in Human Environments: Case Studies of Agent Orange Use in Vietnam, 1965-1970 and Methyl Mercury in Minamata Bay, Japan, 1932-1968**

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### **Introduction**

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Allied bombs destroyed much of the manufacturing capabilities of post war Japan. Industries with no war applications were spared. So the importance of those industries was critical to the rebuilding of the Japanese economy. This importance exaggerated the value of the companies and caused the government to overlook dubious practices and, in effect, side with the companies when issues pitted the citizenry against them.

The deep jungles of Vietnam helped the North Vietnamese Army conceal their actions during the Vietnam-American War. The American strategy of defoliating the forests was considered an effective way to overcome that problem. The U.S. military's need to help their troops blurred their understanding of the consequences of their tactics.

These two cases provide opportunities for students to build informed, objective views of how government and industry get into difficult, if not impossible, situations by slowly pushing the boundaries of ethics and morals until it is too late. The questions that follow the situations described continue to be analyzed and the answers continued to be assessed and judged.

Pride, greed, and guilt can cloud righteous vision. Students will research, analyze, and debate the facts, reaching their own conclusions regarding what, when, and how the principal characters could have (or should have) responded. During the unit, they will learn about persistence of chemicals, ecosystems, politics, genetics, and environment.

### **Rationale**

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While students and teachers are trying to cram brains full of facts and formulas, students are slowly slipping down in the how-to-think area. Being able to consider, rationally, different perspectives, opinions, and different options, and being able to communicate the results of that thinking is a skill that is getting too little

attention. That skill is not on the test, but without it, success on the test is an elusive prize.

This unit uses the discussion (or "case study") approach combined with hands on (demonstration) lessons to address New Mexico state science content standards while teaching skills in thinking, analyzing, judging, and communicating. My students will express their learning through debate and discussion, essays, presentations, and exams. Their competence and confidence will increase through their understanding of issues and questions. This understanding will develop through debating, listening, reasoning and through research.

With pressure on the school to make Adequate Yearly Progress (AYP), there can be a tendency to try and fill the students' minds with facts and formulas, theories and concepts, and methods and strategies. This might be a great way to learn test taking, and test taking might be a great skill to have in its own rite. But knowing how to think, reason, research, and rationalize is universally valued in any field of endeavor. Ironically, they are missed mostly when the pressure is on to pass the test.

## Background

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### War

It is said Napoleon once claimed "An army marches on its stomach." <sup>1</sup> Clearly, his meaning was that, in war, your enemy will submit if you deny him nourishment. Napoleon was on to something - and he created an Empire.

General William Tecumseh Sherman is famous for his "scorched earth" policy during the American Civil War, when he made the infamous March to the Sea - denying sustenance to the remaining soldiers and civilians of the Confederacy. <sup>2,2a</sup>

In 1864, Christopher [Kit] Carson destroyed the gardens, crop lands, and orchards of the Navajo in Canyon DeChelly, Arizona, to force them into submission. <sup>3,3a,3b</sup> In all three scenarios, the antagonist forced his enemy to submit by denying him food and shelter. Napoleon created an empire for France, Sherman crushed the remaining rebel resistance in the Confederacy, and Carson forced the Navajo on their inglorious "Long Walk" to Fort Sumner, New Mexico, after their attempts at waiting out the US Army failed.

The strategy of starving your enemy of food and shelter has a long, successful history. But it does not always work. The U.S. tried this tactic in the war against Vietnam in the 1960s. The implementation of the plan included the use of herbicides. <sup>4</sup> At a certain point in 1969 or 1970, a command decision was made to stop using Agent Orange. (Discussion point - Is denying your enemy shelter and food a good way to fight? What are some upsides and downsides to using herbicides in war? Discuss alternatives and demonstrate understanding using role-plays)

### Business

The number of stories of businesses that push the ethics envelope, in a community setting, are legion. Valuing profits over ethics is an old story in business. Retirement investments, dangerous sewage disposal, animal and human abuses, and environmental destruction do not really surprise us when we hear about them - even though they are definitely shocking.

In Minamata, Japan, the town's economic well being rested on, or was at least enhanced by, the presence of Nippon Chisso - a company that had a thriving factory in Minamata starting in 1908 and continuing to this day. Originally a fertilizer factory, it later turned to manufacturing plastics. The ownership and management of the factory were not immediately aware of the degree of danger the waste being dumped into the bay, and disrupting the local population and environment, presented. People - mostly the less well off - were ingesting methyl mercury from the fish they caught. The Minamata Bay became a toxic pool. The fishermen were unable to make it better or even protect themselves and their families. Eventually, Chisso was forced to recognize what was happening and make some restitution. (Discussion point - When a company is responsible for the financial well being of a community, how can they make decisions regarding environmental problems resulting from their work?)

In the two cases mentioned above, there were positive, beneficial aspects and negative consequences to the essential issues. The town and the factory were both making good money in Minamata. At what point did their negligence become irresponsible, or worse? In Vietnam, herbicides were used effectively to clear forests, but not so effectively for protecting troops or discouraging the enemy.

The underlying questions in this unit concern the ethics of using certain tactics and strategies in war or business. The results of using Agent Orange and other herbicides are not even debatable. It did not serve its purpose, period. That's bad, but what's worse is how that the program, Operation Ranch Hand, left behind damaged people on both sides of the conflict and total devastation of a rich, diverse, ecosystem. (Discussion point - Do the intentions of Operation Ranch Hand's planners mitigate the outcome of their plan? If destruction of pristine parkland was thought to be essential for winning a battle, should that destruction take place?)

## **Tactics in war**

In the 1930s, synthetic compounds designed to control plant growth were created to help farmers in eradicating weeds. The chemicals were also found to have military applications. One of the more effective herbicides was called 2,4-D. During WWII, the U.S. Army worked on refining herbicides and came up with one called 2,4,5-T, which was an easier and safer weed killer to handle. In 1960, the U.S. Army used different mixtures of those two compounds to spray crops and jungle land in Vietnam. A stripe, or band, of color painted on the barrels used to store and ship them identified the mixtures. The chemicals were known as Blue, White, Purple, Green, and Pink (based on the colored stripe). Later, to make it clearer that the colors represented a substance and were actually nouns, the press coined new names for these herbicides, "Agent Blue," "Agent White," "Agent Purple" etc.

The defoliation program, called Operation Ranch Hand, had three purposes. They were; A. to deny the enemy cover from which they could attack and hurt our soldiers, B. to clear large staging areas so our military could see what was coming, and C. to destroy food crops, which would, hopefully, discourage the enemy and contribute to their decision to give up. <sup>5</sup>

The Vietnamese did not lose heart and that misguided mentality (to try and coerce submission through hunger) probably cost the U.S. dearly by denying them the good will of the people. After the U.S. bombed the countryside in an effort to kill the enemy of that countryside, that enemy was as likely to help rebuild the bombed homes, fields, and community buildings as they were to leave. If the plan worked, the U.S. might have won the war. Then they could have written the history and McNamara could be added to the list with General Sherman and Kit Carson. (Discussion point - at what point/s should the U.S. have stopped and reevaluated the herbicide program? Maybe they did, and if so, how did they come to the conclusions they

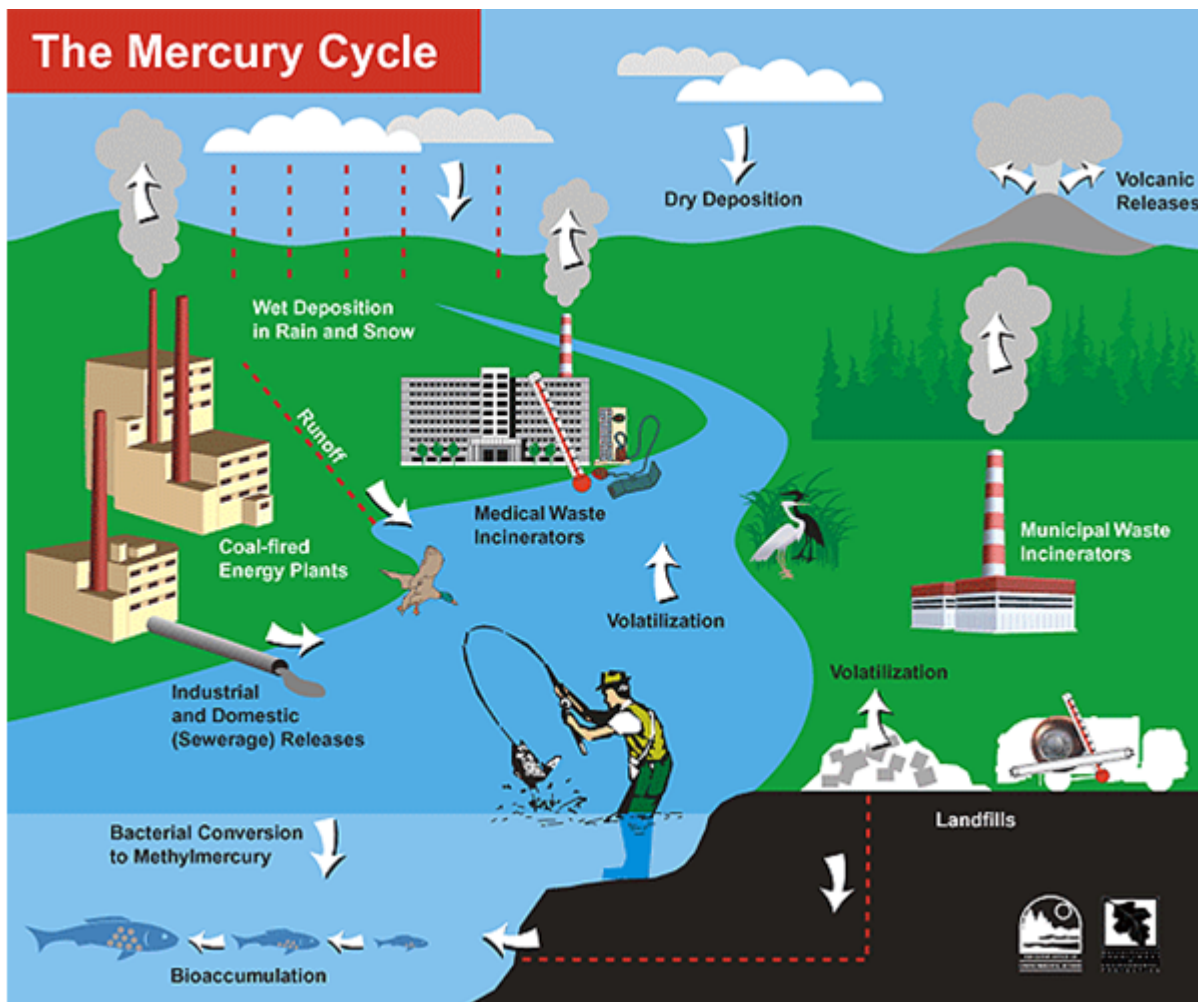
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It took about 10 years for the U.S. to respond to the disastrous misuse of chemicals in Vietnam. They mostly took care of their own veterans and mostly ignored the injured Vietnamese. Surprisingly, the Vietnamese continue to feel affection for the American people - though they are just a little dubious with regard to the American government. In fact, the Travel/AOL website lists Vietnam as one of the top 10 places to visit that loves Americans! <sup>6</sup>

Who is responsible for that? What happened, and what should be done? What should have been done? What have we learned? What activities have we been involved in since then that can demonstrate we have or have not learned from our Vietnam experience? How about our forays into the Middle East and Persia; what about our standing in the international community? These questions will be addressed in this curriculum unit during a daily newspaper check.

### Tactics in business

In 1932, when Chisso started making vinyl chloride and acetaldehyde, people didn't know that methyl mercury would be a byproduct, or what methyl mercury would do to people, or how it would behave in the environment. Some people may have known that it was flowing, along with other heavy metals, from the factory into the bay (see diagram 1, below) <sup>7</sup>, but if so, it was not considered a problem great enough to do anything about.



## Diagram 1

The fishing areas around Minamata were becoming less productive. But it was cheaper for Chisso to pay the fishermen a certain amount for their lost revenue than it was to figure out what caused it and what to do about it. So Chisso "paid indemnity" to the fishermen, who accepted it and considered the payments the right thing to do. The indemnity payments had been part of Chisso's budget since 1925, seven years before they started making acetaldehyde. (Discussion point - why did Chisso give indemnity payments to the fishermen? Discuss options and how this precedent affected changes).

Much later, the facts were realized. Chisso was more interested in saving the factory (with its associated jobs), their profits, and their business reputation than in fixing the problems and helping the victims. Although some of the people in Minamata were horribly hurt, many of the people were not hurt, and those were often afraid of losing their jobs should the factory be deemed responsible for the town's problems. The issue was causing serious rifts in the community.

Who knew what, and when in Minamata, Japan? How should the government and the Chisso company respond? Have other similar companies looked at Chisso's experience and changed their methods of doing business? These questions will be considered in the coming unit.

### *Agent Orange in Vietnam*

Early on in the war, certain specific areas were identified for spraying with herbicides. Different areas considered useful to the enemy for either food or shelter were recognized as appropriate. These areas, in the early days of using herbicides, received only about three-gallons per acre. By early 1965, [Agent] Orange, a combination of equal parts 2,4-D and 2,4,5-T was mixed with diesel fuel or kerosene and became the herbicide of choice. It was especially good at killing broad-leaved and woody vegetation. By 1969, the U.S. was spraying 3.25 million gallons (compared to about 330,000 gallons in 1965). In April of 1970, after spraying 11.2 million gallons, the use of Agent Orange ended. Over 11 percent of South Vietnam's land area was sprayed. That amount accounted for 60 percent of all the herbicides used Vietnam. <sup>8</sup>

As early as 1952, Monsanto Chemical Company told the army that 2,4,5-T had toxic substances in it. In 1963, the army ran its own tests and found 2,4,5-T caused an increased risk of some skin conditions including chloracne and respiratory irritations - especially when applied by inexperienced handlers and even more so still when applied in high concentrations. <sup>9</sup>

Ironically, it was not the 2,4,5-T itself that was dangerous rather, a substance created during the manufacture of it that remained in the final product. This substance's chemical name is 2,3,7,8 tetrachlorodibenzo-p-dioxin, or TCDD, "perhaps the most toxic molecule ever synthesized by man." <sup>10</sup> Galston reported, in 1979, that concentrations of TCDD as low as 5 parts per trillion (about 1 drop in 4 million gallons) can cause cancer in rats if applied daily. <sup>11</sup> TCDD is also a reproductive toxin and likely disrupts the human endocrine and immune system. <sup>12</sup> The World Health Organization (WHO) claims dioxin is one of the most toxic chemicals we humans have come up with so far. The WHO calls Dioxins "persistent organic pollutants," and says they are "of concern because of their highly toxic potential." <sup>13</sup> They are chemically stable and absorb in fatty tissue for up to eleven years. When distributed in the environment, dioxins accumulate in the food chain, in higher concentrations as the chain goes higher. (See diagram 2, below, for model of bioaccumulation of mercury. The dioxin model would be the same, except it would involve more land animals) <sup>8</sup>



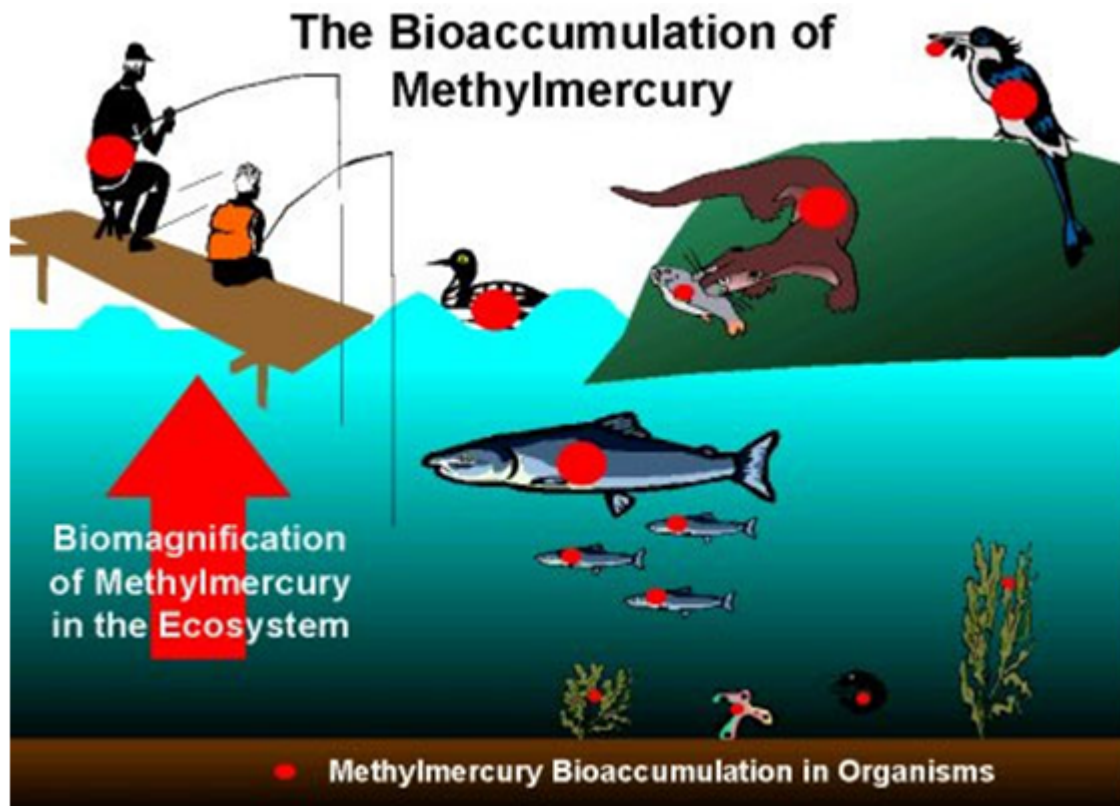


Diagram 2

Chronic exposure of animals to dioxins has caused various cancers. The International Agency for Research on Cancer (IARC) classified TCDD as a "known human carcinogen."<sup>14,15</sup> Of course, an important key in this designation is the amount of TCDD/dioxins one is exposed to. The EPA and USDA have a mysterious way of deciding how much exposure is "safe."<sup>16</sup> To be sure, dioxins are found in nature and most everyone is exposed to them in some degree. Infants and fetuses are more susceptible to problems than adults, as are people with certain diets (e.g., who consume more fish) due to their culture. People who live in certain areas (e.g., near pulp and paper industries or incineration plants) are also more likely to experience problems. Globally, human exposure to dioxins is mostly through food, mostly meat, dairy, fish and shellfish.<sup>17</sup>

Knowing how much TCDD exposure people were subjected to or how much of it was inhaled in Vietnam is impossible to tell. The Agent Orange left over after the war averaged about 2 parts per million (ppm). Some of the samples had as much as 140 ppm.<sup>18</sup> The amount sprayed in any given place and time - and on any particular people, plants, or animals is impossible to know. What is known is that 11.2 million gallons of Agent Orange was sprayed over 1.4 billion hectares, more than 11 percent of the land area of Vietnam.<sup>19</sup> Although the actual amounts sprayed on certain areas are known, it is impossible to know how much reached the ground where it could get in, or on, people. This is important in terms of this unit because it is indicative of the confusion, fear, and deception surrounding the use of Agent Orange and the subsequent effects on people - both U.S. and Vietnamese. (Discussion point - How important is it for the government to know exactly how much toxic herbicide is applied to the land during war? Does it matter if the actual land is "enemy" land or "ally" land with enemies on it?)

### Results

Anecdotal evidence that dioxin had contaminated the herbicide, 2,4,5-T, started coming out in 1969, when the Curriculum Unit 09.07.04

Saigon press reported "unexplained birth abnormalities [beginning in 1967]" - which was the same time that use of Agent Orange started taking off. <sup>20</sup>

Seventy-nine workers at a 2,4,5-T plant in Chesterfield, England developed chloracne (a debilitating skin condition) after an explosion at the plant in 1968, and several died of liver damage. <sup>20</sup>

In 1971, waste oil was used to spray on roads for dust control in the town of Times Beach, in eastern Missouri. Eventually, it was discovered that the truck used to carry the oil was contaminated with dioxin because it was used earlier to remove clay and water from a plant that manufactured Agent Orange. The material being hauled from that plant contained dioxin. Even after dumping the clay and water out, dioxin residue stayed in the truck and contaminated the used oil. The contaminated oil was responsible for killing animals in town. Finally, fourteen years after the spraying began, the town was evacuated and abandoned. The 2,000 residents were bought out and they moved to other towns. <sup>21,22</sup>

In 1978, Maude deVictor, whose job included helping Vietnam veterans with their veteran benefits heard about a former Vietnam soldier who claimed that his cancer, which was terminal, was related to his exposure to Agent Orange. He got her attention and she started talking to other veterans' widows and looking into other veterans' problems. She thought she noticed a pattern and began looking for support from the Veteran's Administration (VA). Instead of getting help, she was met with resistance. <sup>23</sup>

The Veterans Administration recognized only Chloracne as a consequence of Agent Orange exposure. Veterans Administration employees were told not to enter questions about dioxin with regard to complaints, and they were told never to use the expression "dioxin poisoning" in any reports. One VA official said Agent Orange was "no more toxic than aspirin." <sup>24</sup>

Between 1961 and 1973, 2.7 million U.S. soldiers served in Vietnam. Approximately 58,000 died. In the same time frame, there is no definitive number of Vietnamese casualties, but the accepted number is approximately between one million and two million. Many Vietnamese were not fighting, and as happens in war, they were innocent victims of their surroundings. The use of Agent Orange affected soldiers in a lot of ways. Agent Orange also had amazing and troubling effects on the civilians of Vietnam. Some of those troubles, resulting from exposure to Agent Orange, include non-Hodgkin's lymphoma, soft tissue sarcoma, Hodgkin's disease, multiple myeloma, respiratory cancers, prostate cancer, type II diabetes, and leukemia. Long-term exposure has been linked to impaired immune systems and affects "developing nervous systems, the endocrine system and reproductive functions." <sup>25,26</sup>

In 1978, the VA set up a registry for veterans who were concerned about exposure to Agent Orange. Over 315,000 Vietnam Vets have registered and completed an examination. Interestingly, The VA does not test veteran's bodies for dioxin levels or try to verify their proximity to the spraying. The Veterans Administration presumes Agent Orange exposure for all vets who ask. There is an assumption that everyone has some dioxin in them and they just can't tell where it came from. It is also notable that many veterans want to be examined (even though they feel fine) - just to be sure. (Discussion point - Should the government give everyone who asks benefits relating to dioxin exposure, even if they were not exposed? Why would the Veterans Administration resist tracking exposure?)

The companies that manufactured and sold the Agent Orange to the government settled a law suit, out of court, for \$ 180 million, giving some plaintiffs as much as a few thousand dollars each. Later, the U.S. veterans won a legislative battle for compensation and they currently "receive \$ 1.52 billion per year in benefits." <sup>27</sup>

See also, appendix A, with compensation package.

### *Agent Orange and the Vietnamese*

Meanwhile, between 2.5 and 4.8 million people in Vietnam were exposed, to Agent Orange where 11.2 million gallons were sprayed between 1965 and 1970. The Vietnamese are having the same problems as the US soldiers. The Vietnamese victims actually have it worse because they have remained in the polluted environment long after the U.S. pulled out. Those people ate plants and animals that were exposed, and in turn concentrated even more of the chemicals in their bodies.

The Vietnamese victims of Agent Orange also sued Dow and Monsanto, the manufacturers. The case was dismissed by the US District Judge who concluded, that "Agent Orange did not constitute a poison weapon prohibited by the Hague Convention of 1907." <sup>28</sup> When the U.S. veterans settled, the courts told the chemical companies that their liability was over. The appeals by Vietnamese were denied, and the U.S. Supreme Court refused to hear the case. In their filings, the chemical companies admitted, "The harm alleged by the victims was foreseeable although not intended." Cohn argues, if it was foreseen, than proceeding is [at least implicit] intent. <sup>27</sup>

Dioxin is a persistent chemical, the nature is such that when the chemical is eaten by animals it is stored in that animal's fatty tissue and transferred to the next animal that eats THAT animal. Since the water that plants use to grow and that animals use to drink was contaminated, the food chain was infected right from the beginning. Fish are prime examples of how persistent chemicals work in the food chain. The little fish eat algae and microscopic animals, larger fish eat those little fish, and still larger fish eat those fish and so on. Eventually humans and larger animals eat the biggest of fish that have several layers of dioxins stored inside of them. (See diagram 2, above) In addition to dioxins stored in animals' fatty tissue, some of the forests that were sprayed in Vietnam have been devastated. If they are able to grow back, it is estimated that it will take 50 - 200 years! <sup>27</sup> The loss of the forest environment has led to the extinction of certain animals which has disrupted the associated communities that depend on them. Without the plants to hold the soil, erosion has clogged rivers and chemicals like dioxin have washed down, contaminating the water. Since the ground is polluted and denuded, the environment is forever changed. Dioxin's, legacy lives on long after the life it affected is gone.

These chemicals cause diseases and birth defects. Children and grandchildren of the people exposed to Agent Orange have physical deformities and mental and physical disabilities. They have compromised immunity systems that subject them to diseases and shortened life spans.

Cohn <sup>27</sup> says that a study commissioned by the US government in 1963 showed that Agent Orange "produced significant deformities in unborn offspring in laboratory animals" and that a leak of that study in 1969 led to the discontinuation of the use of Agent Orange in 1970. <sup>29</sup>



## Final Questions

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In 2009, an International People's Tribunal of Conscience in Support of the Vietnamese Victims of Agent Orange gathered in Paris, hearing testimony from 27 victims, witnesses and scientific experts. Testimony from chemists, doctors, scientists and victims <sup>30</sup> suggest costs of rehabilitation of the environment and the people including 24 hour care in the billions of dollars. President Richard Nixon promised \$ 3.25 billion for reconstruction "without any preconditions," <sup>27</sup> but that money was never granted by congress.

Why did this situation develop? If the US government knew of the dangers to people and the environment from using Agent Orange as early as 1963, why did they use it?

Perhaps they thought they were going to win (when has a country gone to war expecting to lose?) and the winners always get to write the history. What went wrong?

## Intermission

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All people want to be good and do the right thing. No people can always do the right thing. Even when we do bad things, we can manage to justify it. Often times, we do something good after the fact to prove that we are still basically good. Governments, businesses, and people can all behave the same way. Think about a time you were involved in dubious behavior, either directly or as a bystander, that began as something righteous - or a time when you were a participant in behavior intended to make up for a questionable decision. You can see how our motives are mostly healthy and positives.

In Vietnam and Minamata Bay, things went horribly wrong. People died - innocent people. Thousands of animals died and the environment was devastated. Humans were maimed and disfigured, families were fractured, and reputations were ruined. In addition, the environment was distressed and the ecology was hugely disrupted.

In some cases, some good came from these disasters. Just as wars lead to some great breakthroughs in technology that help mankind, sometimes horrible accidents can lead to better understanding. What good things have come from war and environmental destruction? What understandings have come out of them?

## Minamata Bay

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### Introduction

Dancing cats, suicidal cats, birds dropping from the air - dead ... it was strange and it was disturbing. Fish were dying and floating in the bay and washing ashore. Numb lips and hands were not worth mentioning. Normal people suddenly began blurting out, as if in the throws of Turrets syndrome. Others began trembling and suddenly slurring words. These symptoms, if not the people themselves, were uncomfortably ignored or

overlooked. It was all very strange, and it was somewhat embarrassing. The town of Minamata was on the rise and nobody wanted to miss out. But there was no mistake; this was a strange and frightening time in Minamata.

## **Rationale**

In this section on Minamata Bay and Minamata Disease, we will address New Mexico science and social studies standards. These standards include knowledge on investigations, atoms, elements, molecules and ecosystems. (Appendix C) We will learn about genetics in terms of congenital disease with United Streaming video and written research. <sup>33</sup> Additionally, students will develop an understanding of how society can sometimes work against itself. We are going to study how different groups and entities have a propensity towards self-interest, especially in the short run that sometimes results in more harm than good.

## **Background**

The town of Minamata is on the island of Kyushu, Japan. Kyushu is the southern most island and the third largest of the four main islands out of the approximately 3,000 making up the Japanese nation. Minamata is in a large, beautiful bay on the west side of Kyushu. Minamata has been a small fishing and farming town for hundreds of years. The people have historically been mostly poor and mostly healthy.

In 1901 a company called Nippon Chisso was looking for a place to build a factory. This would be an economic boon for any town that had visions of moving up in the world, the Minamatans approved the project and in 1907, Chisso built a fertilizer factory in Minamata. The people were disappointed to find out that all the "good" jobs went to educated people from other towns and the Minamatans only got the "blue collar" factory labor jobs. Still, there were plenty of jobs and paychecks and the town grew, and the citizens prospered. The fishing and farming industries continued to be very important in Minamata.

The town and the factory both continued to grow. Between 1926 and 1943, Chisso was responsible for about 50 percent of the taxes in Minamata and accounted for about 25 percent of employment. By mid 1956, Chisso Corporation employed nearly 60 percent of the town's workforce, <sup>32</sup> including a company hospital.

Chisso dumped the factory waste into Minamata Bay - not an unusual practice, with the result being fewer fish in the bay. Knowing the factory probably had much to do with the change in fish population, Chisso gave a certain amount of money to the fisherman, periodically, for their inconvenience. Some people call the payments "hush money," where others call it "indemnity money" for possible damage to fishing waters. <sup>33</sup> This system was satisfactory for all the principal parties. The factory could continue with business as usual. Giving money to make up the fishermen's losses was cheaper than disposing of the waste in a more environmentally responsible manner. The fishermen were compensated economically, and the town continued to prosper.

In 1932, Chisso started manufacturing vinyl chloride and acetic acid, used in making plastics and rubber products. These chemicals use mercury in their manufacture. A byproduct of this process is a highly toxic organic mercury compound, methyl mercury. Over the years, fish continued dying, and the payoffs to the fishermen for the loss of their fishing habitat also continued. The fishermen's acceptance of the buyouts was an implicit sign that they agreed, even if they didn't like it. By this time, the Chisso factory had become part of the town's identity and the Minamata economy depended on its success. The fishermen were paid for their lost fish and everything else in their lives was fine. (Discussion point - is it right for a rich company to pay affected citizens instead of correcting the problem? Is it right for the citizens to take the money without questioning the cause of the problem?)

## *Strange goings on*

The cats started acting strange in the early 1950s. Some people called it the Dancing Cat Disease.<sup>33,34</sup> Some said the cats were committing suicide when they ran towards, and leaped into, the sea and died. About the same time, strange things were happening to people too - but this was not something they wanted to talk about. There were concerns about contagiousness, about insanity, or that they were possessed by the devil - for with their contorting faces, they looked like monsters.<sup>35</sup> People would suddenly shout or howl, sometimes for hours. Faces would twitch and warp. Limbs twisted and people would fall down. In addition to the suicidal dancing cats, birds were falling dead from the air. Dogs would disappear and be found dead far away. Seaweed stopped growing in the bay and fishermen were catching two-headed fish.<sup>35</sup>

As the occurrences increased in frequency and intensity, the symptoms were given a name, the "Strange Disease."<sup>32</sup> As the symptoms and the victims increased, the condition started being called "Minamata Disease." Between the 1930s and 1956, when researchers discovered the cause of Minamata disease, the town and surrounding area was being devastated by heavy-metal poisoning, primarily from mercury, that had built up in the food chain of the sea, ending in the diets of the families in and around Minamata. (See diagram 2, above) They did not know what was going on. Fear of contagiousness led to people ostracizing and shunning victims. One story told of a craftsman in Minamata, Yahei Ikeda, who blamed the victims for their troubles, and encouraged people to avoid them. Neighbors turned against neighbors in those days. Eventually, some of those who felt strongest, like Ikeda, that the victims deserved their fate had the treatment turned on them when they showed symptoms of the disease.<sup>32</sup> (discussion point - What can people do when they need help, but their community fears their disability?)

## **Discovery**

As noted earlier, the first mention of the problems in Minamata was in 1950 when the cats seemingly went crazy before suddenly dying. Then the birds started falling from the sky, dogs disappeared, and fish floated. It was happening to people too, but quietly because people were afraid of being shunned and hated. Nobody knew what caused it or if it was contagious. It was a great mystery.

Eventually, a Chisso company doctor, Dr. Hajime Hosokawa figured it out in 1956. Dr. Hosokawa was given the task of finding the source of the disease. When he discovered it was coming from the factory, Hosokawa was told to stop his research and keep quiet.<sup>35</sup> The next year, Kumamoto University made a study that supported Hosokawa's findings, that heavy metals in the fish was causing the disease.

People started finding out, but they didn't want to say anything because in their culture people just didn't complain - especially if it might cost them or their neighbors their jobs. They preferred to be stoic. Chisso was, by this time, complicit, or ignorant, but in either case, they were clearly more concerned with profits than the health of their workers and the town. In 1958, the government stepped in to help Chisso by making it look like the company was going responsible. One way they did this was to ban the sale of fish caught in the bay. In banning the sale of fish, the government unintentionally forced the fishermen and their families to eat even more of the contaminated fish, since they could not make any money to buy "good" food. If the government banned consumption of the fish, Chisso (or the government) would have to help those fishermen financially. (Discussion point - How can you decide who is responsible? The doctor left quietly, Chisso said nothing, the government side-stepped the problem)

Finally, in 1959, Kumamoto University identified the exact substance, methyl mercury, and where it came

from - Chisso. Chisso paid "condolence money" without admitting responsibility. <sup>34</sup> The victims were pressured into taking the money by their community, where challenging the town's main employer was considered selfish, even if they did not want to. The money amounted to \$ 83 per child with the disease and \$ 278 for an adult. In the event of a death, the family would get \$ 889. <sup>36</sup>

The government wanted Chisso to take care of it, so they paid the money to the victims and then they moved the waste to another location - from the bay to the Minamata River. That led to more dead animals and more sick people in different areas and just more problems. So they bought a new waste treatment process called a Cyclator Purification System. Chisso made a big deal out of the unveiling of the new wastewater treatment. This gave the citizenry confidence and they were no longer as afraid of the fish. In later testimony, it came out that the Cyclator was installed "as a social solution" and did nothing to remove organic mercury." <sup>35</sup> Chisso knew it would not work and they kept dumping the same waste in the same way. The community, feeling safer, ate more fish.

By 1968, there was new technology that made the process Chisso used obsolete for making their chemical products. They used new processes that did not require mercury. By 1969, other than congenital cases, new cases of Minamata Disease were fewer and fewer until there were no more.

## Resolution

After all alternative explanations for the cause of Minamata Disease were exhausted (e.g., dumped military munitions), <sup>32</sup> and after the company stopped using mercury, the head of Chisso offered sympathy and officially apologized. In 1972, Chisso was officially held "responsible for their negligence" with regard to their holding back of information before the Kumamoto University report verified Hosakawa's findings in 1959. Chisso never accepted responsibility in their apology. The question of responsibility is difficult to parse if you consider the times - historically, medically, and culturally. Amends and compensation were handled through the courts. Over the next 20 - 30 years, monetary amounts were disbursed. <sup>34,36</sup> Most of the people who got sick from eating fish have died and only those who were born with it are left - mostly living in horrible conditions and dying young.

Eventually, 1.5 million cubic meters of contaminated sludge were removed from Minamata Bay. There was enough mercury in there to make it worth mining, which Chisso did. Chisso paid about two thirds of the cost to clean the bay. Today, in Minamata, there is a large museum dedicated to the environment and memorial commemorating the unfortunate period in Japan's history.

## Activities

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The activities for this unit include making a TV news style video explaining what happened in Minamata or reporting on how Agent Orange is helping or hurting the war effort in Vietnam. Students will also debate the question of responsibility and consequences for the cases noted above, and participate in hands on experiments that demonstrate chemical persistence in animals and the environment. They will explore ecosystems, habitat, food webs, and how changes in the environment, including both those initiated by nature and human behavior, effect organisms. Finally, the students will learn about the periodic table of the elements, behavior of molecules, and the physical states of matter.

My students will learn about the science and social studies standards associated with this unit by studying cases where these topics were played out. The case study, or discussion method, of learning will give the students meaningful grounding in the background of the cases, leading to the content knowledge intended in the unit. Students will learn through lecture, discussion, video (see resources) and research.

### **Discussion**

One important consideration when teaching a discussion based class is choosing good places in the case to stop and let the students discuss important and interesting issues. Getting the students interested in the general stories before assigning them readings is an important aspect to having them "buy in" to the concept of learning through case studies. Mixing readings with teacher narrative and discussion allows the teacher to determine students' interest level and refresh waning interest and participation by changing the type of lessons. Some articles are listed in the student resources and end notes. Other articles can be found through student research. For the teacher narrative part, the teacher can use the stories as written above. Points to stop and initiate discussion are noted parenthetically (discussion point).

### **TV news style video**

Students will use their knowledge and informed opinions to create a report explaining what happened and what the issues are concerning one of the featured cases. Each team of students will work on a case as assigned by the teacher. Students will compile a corpus of information and methodically distill it until it is a clear and concise five to ten minute presentation. They will present the information in the style of a news program with possible segments including sports, weather, news, human interest, etc.

### **Debate**

Students will be assigned a position to advocate concerning one of the featured cases. They will conduct research to prepare arguments advancing their position. They will practice explaining, taking into consideration their audiences, their arguments using note cards, images, charts, etc.

### **Chemical persistence**

See student resources, "chemical persistence."

Students will use various models to demonstrate how certain substances accumulate in specific environments. For more information on bioaccumulation models for classrooms, Email me at [jeffdavispost.harvard.edu](mailto:jeffdavispost.harvard.edu).

### **Newspaper check**

Each day, certain students will be assigned to report on interesting and relevant news concerning politics, environment, ethics, etc.

### **Ecosystems - nature and human changes**

Students will complete activities provided by the National Audubon Society on ecosystems. Contact the Audubon Society, they are eager to help in this endeavor.

Elements, molecules, and periodic table will be taught using Scott Foresman science programs.



## Appendix A

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The following is from the state of NJ Veteran Affairs Updates. Rudi Williams reports on the "New VA Secretary" concerning VA benefits. ([http://www.state.nj.us/military/veterans/journal/spring2001/va\\_updates.html](http://www.state.nj.us/military/veterans/journal/spring2001/va_updates.html))

"The \$ 1.525 billion increase in VA medical care would include \$ 141 million for mental health programs, \$ 100 million for higher pharmacy costs, \$ 88 million for long-term care, \$ 75 million for staff to reduce waiting times, \$ 68 million for emergency care, \$ 30 million for homeless programs, \$ 23 million for spinal cord injury programs, and \$ 1 billion to adjust for inflation.

A \$ 130 million increase proposed for the Veterans Benefits Administration includes the \$ 49.8 million for an additional 830 full-time employees to help deal with a backlog in claims processing that is getting worse.

In addition to the \$ 2.1 billion increase in discretionary spending, the VA Committee recommends \$ 300 million in additional direct spending for further benefit increases in both the Montgomery GI Bill and the Veterans Opportunities Act of 2001.

The VA Committee also recommends a \$ 325 million increase for VA medical facility repair. This would fund the Veterans Hospitals Emergency Repair Act which would authorize a two-year total of \$ 550 million. The VA Committee also seeks modest increases for state nursing home and cemetery grants programs as well as for the National Cemetery Administration."

## Appendix B

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On May 15 and 16 of this year, the International Peoples' Tribunal of Conscience in Support of the Vietnamese Victims of Agent Orange convened in Paris and heard testimony from 27 victims, witnesses and scientific experts. Seven people from three continents served as judges of the Tribunal, which was sponsored by the International Association of Democratic Lawyers (IADL).

Testimony given by the witnesses showed the following:

Mai Giang Vu, a member of the Army of South Vietnam, carried barrels of the chemicals on his back. His two sons could not walk or function normally, their limbs gradually "curled up" and they could only crawl. They died at the ages of 23 and 25.

Pham The Minh, whose parents also served in the South Vietnamese Army, showed the Tribunal his severely deformed, crooked, skinny legs; he has great difficulty walking, as well as digestive and pulmonary diseases.

To Nga Tran is a French Vietnamese who worked as a journalist during the spraying. Her daughter weighed 6.6 pounds at the age of three months. Her skin began shredding and she could not bear to have skin contact or simple demonstrations of love. She died at 17 months, weighing 6.6 pounds. Ms. To described a woman who gave birth to a "ball" with no human form. Many children are born without brains; others make inhuman sounds.

Rosemarie Hohn Mizo is the widow of George Mizo, who served in the US Army in Vietnam in 1967. He slept on contaminated ground and consumed food and drink that were also contaminated. George refused to serve after he was wounded for the third time; he was court-martialed and sentenced to 2-1/2 years in prison and a dishonorable discharge. George helped found the Friendship Village where Vietnamese victims live in a supportive environment. He died from conditions related to his exposure to Agent Orange.

Georges Doussin, co-founder of the Friendship Village, visited a dormitory where he saw 50 highly deformed "monsters," who produced inhuman sounds. One man whose parent had been exposed to Agent Orange had four toes on each foot. Doussin said Agent Orange creates "total anarchy in evolution."

Dr. Nguyen Thi Ngoc Phuong, from Tu Du Hospital in Ho Chi Minh City (Saigon), sees many children born without arms and/or legs, without heads or faces, and without a brain chamber. According to the World Health Organization, only 1-4 parts per trillion (PPT) of Dioxin in breast milk can cause severe deformities in fetuses and even death. But up to 1,450 PPT are found in maternal milk in Vietnam.

## Appendix C

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This unit includes state standards in social studies and in science. The New Mexico Standards for science include understanding atoms and molecules and how they behave in different conditions. The standards also include students learning about different kinds of investigations for different kinds of questions. In addition, the unit will address standards concerning ecosystems, food chains, and the relationships between different organisms are addressed along with the impact that human activity has on the environment. Social studies standards concerning the history of the United States are included as well (at the time of this writing, state standards for New Mexico are under construction and unavailable).

Strand I, Standard 1, Benchmark 1,

Performance Standards: 1. formulate testable questions, make systematic observations, develop logical conclusions, and communicate findings. 3. Use graphic representations to present data and produce explanations for investigations. 5. Communicate the steps and results of a scientific investigation.

Strand I, Standard 1, Benchmark 2,

Performance Standards: 1. Understand that different kinds of investigations are used to answer different kinds of questions. 2. Understand that scientific conclusions are subject to peer and public review.

Strand I, Standard 1, Benchmark 3,

Performance Standards: 1. Use appropriate units to make precise and varied measurements. 3. Make predictions based on analyses of data, observations, and explanations.

Strand II, Standard 1, Benchmark 1

Performance Standards: 1. Describe properties of the three (4) states of matter. 3. Know that matter is made up of particles that can combine to form molecules and that these particles are too small to see with the naked eye. 4. Know that the periodic table is a chart of the pure elements that make up all matter.

Strand II, Standard 2, Benchmark 2,

Performance Standards: 1. Identify the components of habitats and ecosystems (producers, consumers, decomposers, predators) 2. Understand how food webs depict relationships between different organisms. 3. Know that changes in the environment can have different effects on different organisms. 4. Describe how human activity impacts the environment.

## Student References

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"The Vietnam War." Digital History. <http://www.digitalhistory.uh.edu/modules/vietnam/index.cfm> (accessed July 14, 2009).

Digital history website - including links to the Vietnam Declaration of Independence, 1945, maps, images, timelines, lesson plans, and more.

Carlton, Mike. "Dispatches from postwar Vietnam - Opinion - smh.com.au." Sydney Morning Herald - Business & World News Australia | smh.com.au. <http://www.smh.com.au/news/opinion/dispatches-from-postwar-vietnam/2008/06/27/1214472765352.html> (accessed July 14, 2009). A Vietnam veteran returns to Vietnam 35 years later and writes about his experience. Excerpt - "We were met everywhere with gentle courtesy. Almost everybody seems to be under the age of 30 and for them the American war, as they call it, is history"

"Reflections From Vietnam." University of Southern Maine.

[http://usm.maine.edu/~atkinson/semesteratsea/pages/reflections\\_from\\_vietnam.htm](http://usm.maine.edu/~atkinson/semesteratsea/pages/reflections_from_vietnam.htm) (accessed July 14, 2009). A visitor from Maine learns about Vietnamese people.

McCornac, Dr. Dennis. "It's a Country, Not a War." Teaching the New Vietnam.

[www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content\\_storage\\_01/0000019b/80/3c/95/9d.pdf](http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/3c/95/9d.pdf) (accessed July 13, 2009). How Vietnam is today, and how it has changed - this is a detailed and comprehensive description.

## Video clips -

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If your school does not allow Youtube downloads, you can save the videos outside of school using free software, "keepvid.com" and use free FLV player found on same site.

<http://www.youtube.com/watch?v=ihFkyPv1jtU> - an effective video including some history and some science. There are videos of Dr. Hosakawa's work and victims of Minamata Disease. (about three minutes)

<http://www.youtube.com/watch?v=dw7cKHpoPe8> - slide show in Spanish featuring Eugene Smith photographs (about four minutes)

<http://www.youtube.com/watch?v=C4sekdyjsjFA> - disturbing film that attempts to describe what it might be like to be a victim of Minamata Disease.

<http://www.youtube.com/watch?v=op49EKr9D70&feature=related> - a video made by students in England as part of a project. They use the news feature idea. The second half of this video has nothing to do with Minamata.

## Chloracne sites

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<http://cybersarges.tripod.com/Chloracne.html> text and a few pictures

<http://cybersarges.tripod.com/AOphotos.html> many pictures and extra links

<http://www.lexic.us/definition-of/chloracne> definition and pictures

<http://rattler-firebird.org/va/agentorange/chloracne.php> fact sheet and pictures

<http://www.corrosion-doctors.org/Elements-Toxic/Minamata-1.htm> overview

<http://science.education.nih.gov/supplements/nih2/chemicals/activities/lesson5.htm> -video on Minamata Case Study

## Chemical persistence

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<http://www.truthout.org/article/kids-safe-chemical-act-empowers-epa-require-chemical-testing>

<http://www.life123.com/home-garden/gardening-tips/organic-gardening/teaching-kids-about-organic-gardening.shtml>

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## Bibliography

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Schuck, Peter H.. Agent Orange on Trial: Mass Toxic Disasters in the Courts, Enlarged Edition (Belknap Press). Cambridge: Belknap Press, 1986.

Wargo, Mr. John. Our Children's Toxic Legacy: How Science and Law Fail to Protect Us from Pesticides. New Haven: Yale University Press, 1996.

## Endnotes

---

1. Moore, Richard . "Napoleon Bonaparte : Napoleonic : Napoleon : Bonaparte : Wars : Napoleon I : Napoleonic History : Military : Napoleonic Era : Battles : Naval : Armies : Uniforms : ." Napoleon Bonaparte : Napoleonic : Napoleon : Bonaparte : Wars : Napoleon I : Napoleonic History : Military : Napoleonic Era : Battles : Naval : Armies : Uniforms : .  
<http://www.napoleonguide.com/> (accessed July 13, 2009).
2. "Sherman's March to the Sea, 1864." EyeWitness to History - history through the eyes of those who lived it.  
<http://www.eyewitnesstohistory.com/sherman.htm>
  - 2a. Clark, Doctor Frank. "Sherman's March to the Sea." South Carolina SC - Genealogical and Historical Websites.  
<http://www.sciway3.net/clark/civilwar/march.html> (accessed July 13, 2009).
3. "The Long Walk of the Navajos." Welcome to Logoi.com, The Online Travel Source.  
[http://www.logoi.com/notes/long\\_walk.html](http://www.logoi.com/notes/long_walk.html) (accessed July 13, 2009). Agoi, 2000 This site has a brief, yet accurate account of the Long Walk of the Navajo. There are also links to more background and detail.
  - 3a. Thompson, Adam J. Teller - stories of my Grandma May, and Grandpa Chee Draper.. "Canyon de Chelly - The Long Walk." Antelope House Tours - Canyon de Chelly - Experience the Beauty - canyondechelly.net.  
[http://www.canyondechelly.net/long\\_walk.html](http://www.canyondechelly.net/long_walk.html) (accessed July 13, 2009). Oral history of the Long Walk of the Navajo as told to Adam Teller by Grandpa Chee Draper.



3b. Sharp, Jay W.. "The Long Walk Trail Of The Navajos." Desert Biomes by DesertUSA.

<http://www.desertusa.com/mag03/trails/trails09.html> (accessed July 13, 2009). Maps, pictures, and first person accounts. Also links to other contemporary historical sites.

4. "Report on DoD research on herbicides outside Vietnam." Veterans Administration Agent Orange docs. [www1.va.gov/agentorange/docs/Report\\_on\\_DoD\\_Herbicides\\_Outside\\_of\\_Vietnam.pdf](http://www1.va.gov/agentorange/docs/Report_on_DoD_Herbicides_Outside_of_Vietnam.pdf) (accessed July 13, 2009). This table shows all the different herbicides, where and when they were tested, and a brief project description. There are 71 trials cited.
5. Silverman, Jacob. "HowStuffWorks "Uses of Agent Orange and Effects on Foliage"." Howstuffworks "Science". <http://science.howstuffworks.com/agent-orange1.htm> (accessed July 13, 2009). This is a great site and explains how and why the U.S. military used herbicides in Vietnam.
6. "10 Countries That Love Americans." Travel - Travel Destinations, Cheap Airline Tickets, Cheap Hotels - AOL Travel. <http://travel.aol.com/travel-ideas/international/galleries/countries-that-love-americans> (accessed July 13, 2009). America On Line Travel site describing world destinations that, as travelers report, are especially friendly to Americans.
7. Thanks to Elizabeth Harvery, YNI Fellow, 2008
8. Schuck, Agent Orange on Trial, 17
9. Schuck, Agent Orange on Trial, 24
10. Galston Arthur, Professor, Department of Biology, Yale University 1955 - 1990
11. Schuck, Agent Orange on Trial, 18
12. Wargo, Our Children's Toxic Legacy, 134
13. "Dioxins and their Effect on Human Health." World Health Organization. [www.who.int/mediacentre/factsheets/fs225/en/index.html](http://www.who.int/mediacentre/factsheets/fs225/en/index.html) (accessed July 13, 2009).
14. "2,3,7,8-Tetrachlorodibenzo p-Dioxin (TCDD); DIOXIN CAS No.1746-01-6 Report on Carcinogens U.S. Department of Health and Human Services Public HealthService National Toxicology Program rev. Jan01." Mindfully.org. <http://www.mindfully.org/Pesticide/Dioxin-TCDD-9th-ROC.htm> (accessed July 16, 2009).
15. "TCDD-Dioxin-Is Listed As "Known Human Carcinogen" In Federal Government's Ninth Report On Carcinogens." Science Daily: News & Articles in Science, Health, Environment & Technology. <http://www.sciencedaily.com/releases/2001/01/010123074358.htm> (accessed July 16, 2009).
16. Wargo, Our Children's Toxic Legacy, 7, 8
17. "Agent Orange Home." U.S. Department of Veterans Administration, Agent Orange. <http://www1.va.gov/Agentorange> (accessed July 13, 2009). Click on the "General Information" link. Other links are also useful.
18. Schuck, Agent Orange on Trial, 18
19. Cohn, Marjorie, and t r u t h o u t | Perspective. "t r u t h o u t | Agent Orange Continues to Poison Vietnam." t r u t h o u t. <http://www.truthout.org/061509R> (accessed July 13, 2009).
20. Schuck, Agent Orange on Trial, 22
21. Weiser, Kathy. "Missouri Legends, Ill Fated Times Beach." Legends of America. <http://www.legendsofamerica.com/MO-TimesBeach.html> (accessed July 13, 2009). This is a great site for odd stories about the country.
22. Leistner, Marilyn, last Mayor of Times Beach, and Missouri. "S/R 7-8: The Times Beach Story (Marilyn Leistner)." Green Parties World Wide. <http://www.greens.org/s-r/078/07-09.html> (accessed July 13, 2009). A fascinating look at the Times Beach story from the mayor at the time of the problems.
23. Schuck, Agent Orange on Trial, 23
24. Schuck, Agent Orange on Trial, 24
25. "Dioxins and their Effect on Human Health." World Health Organization. [www.who.int/mediacentre/factsheets/fs225/en/index.html](http://www.who.int/mediacentre/factsheets/fs225/en/index.html) (accessed July 13, 2009).
26. "Information for Veterans Who Served in Vietnam." U.S. Department of Veterans Affairs . <http://www1.va.gov/agentorange/docs/AOIB10-49JUL03.pdf> accessed July 13, 2009).

27. Cohn, Marjorie. "Agent Orange Continues to Poison Vietnam." Global Sisterhood Network. [www.global-sisterhood-network.org/content/view/2314/59](http://www.global-sisterhood-network.org/content/view/2314/59) (accessed July 13, 2009).
28. Schuck, Agent Orange on Trial, 19
29. Schuck, Agent Orange on Trial, 20
30. See Appendix B for excerpts from testimony from the International People's Tribunal of Conscience in Support of the Vietnamese Victims of Agent Orange
31. Allchin, Douglas . "The Tragedy and Triumph of Minamata." The Biology Teacher, June 1999.
32. Johnston, Eric. "Quite Heroism Amid Tragedy." Japan Times, May 2, 2006. <http://search.japantimes.co.jp/cgi-bin/nn20060502f1.html> (accessed July 14, 2009). A heart rending account of a 71 year old victim of Minamata Disease.
33. Harada, M.D. PhD, Masazumi. "Minamata Disease and the Mercury Pollution of the Globe." Environmental Information Network for Asia and the Pacific Homepage. <http://www.einap.org/envdis/Minamata.html> (accessed August 6, 2009).
34. Allchin, Douglas . "The Tragedy and Triumph of Minamata." The Biology Teacher, June 1999.
35. Rogers, Mike. "Minamata: Real Life Horror Show" Lew Rockwell.com, 2004. (accessed July 14)
36. "Minamata Disease The History and Measures - Chapter 4 [MOE]." Ministry of the Environment, Government of Japan. 2002 <http://www.env.go.jp/en/chemi/hs/minamata2002/ch4.html> (accessed July 14, 2009) Page 6 of this sight has a table with the compensation agreement

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