

## **WE CAN CLEAN UP OUR ACTS**

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### **Overview**

This unit is designed for a 10<sup>th</sup> grade chemistry class. By taking a historical view of the smoke pollution in Pittsburgh and the long struggle to solve the problem, students will be able to better understand the issues involved and the timing and compromises which are necessary for the successful resolution of any problem. The students will become citizens of Pittsburgh in the year 1900. They will represent different constituent groups – mill workers, families of the workers, mill owners, society women and politicians. In these roles they will develop an understanding of the problem from different perspectives. As we trace the history of resolution they will identify each group's response or resistance to suggestions. The purpose is to inspire the students that change can be effected if there is commitment and a willingness to share point of views. In conclusion the students will examine a current environmental problem and determine what role they might play in a local solution.

### **Rationale**

I believe that any science curriculum should spend some time discussing the impact of science and technology on society. I feel a strong need to answer the universal question of all students, "Why do I need to learn chemistry? I'm not going to be a chemist." I suggest to them, that as future citizens they will be voting on some very tough issues around current research and technology. They will need to discriminate between fact, hype and lies. So as part of my 10<sup>th</sup> grade chemistry class I discuss the impact that science and technology has had on society and the environment. As we discuss many environmental problems, I find that the students are very aware of the problems yet feel that these problems do not belong to them. In fact these same problems have been presented throughout most of their education. The problems have been around for all the student's lives and life if anything has become better for theses kids. Society seems to just accept the problems and as yet there appear to be no harmful consequences. These young people also feel overwhelmed by the enormity and quantity of the problems. They feel

that they can make no difference, so why even try. The problems seem so far into the future and so again why should young people bother. Claiming responsibility and feeling a need to protect future generations is not common among adolescents. But at this age they need a sense of optimism that change can be implemented and life improved. Hopefully they will also begin to want to assume the responsibility for change in their own environment.

Adolescents are generally self-centered. So by addressing problems literally in their own backyard, I am hoping that they will be more convinced. Pittsburgh at the beginning of the 20<sup>th</sup> century was nicknamed "The Smokey City" and indeed it earned this name. At three in the afternoon the sky was so dark that it seemed as if it was midnight. It was also called the "two shirt city", as clothing was black by midday and a change was needed. It was an endless battle to keep house and clothing clean. Vegetation was sparse and there were many barren lots of land. "The trees are dwarfed and the foliage withered by the fumes, the air is gray and only from the top of the hills, above the smoke is the sky blue." Pittsburgh Survey. Visitors to nineteenth-century Pittsburgh agreed that it looked like "hell with the lid off" its skies colored by the fire and dust spewing forth from the teeming iron and steel mills (Paul Kellogg, Pittsburgh Survey). Today the air quality can match that of any city and there is a clear vista as you drive through the Fort Pitt tunnel to see a city silhouetted against a smoke-free sky. There are ample photographs to provide proof of how bad the air was in Pittsburgh. Today students experience a far cleaner air and so enjoy the benefits of actions taken many years ago. This more localized focus should make the problems real and today's improved situation provide concrete proof that changes *can* be made. By using a Pittsburgh example, students recognize that they are the beneficiaries of the efforts of others and hopefully feel the obligation to continue that legacy.

Although I teach a chemistry class I am less interested in the science behind the problems and their solution and more interested in examining the economic and political implications, the barriers to implementation and the critical factors for success. For many of the environmental problems that we face, solutions have been clearly identified that would lead to a reduction in the problems, yet no changes have been made. Knowing the solutions and what needs to be done does not necessarily mean that a change will be effected. It is important to understand what it takes to bring about change and why it is not an easy process. Students see many environmental problems, in fact most problems, as one-dimensional and do not understand the complexity of the issues. Students are not aware of other viewpoints or understand the economic repercussions of environmental problems and their solutions. Again change can only be effected if you have an understanding of the concerns of all stakeholders. I would like to use the air problems in Pittsburgh to examine all these issues.

This unit is designed for a regular 10<sup>th</sup> grade chemistry class. Many of these students need to improve their reading and interpretation of documents. They need to be continually pushed to interpret data and problem solve. The mathematics of chemistry should be the most difficult part of the course, but they can in fact be trained to do the problems. They resist though any kind of interpretation or inference making. It is important that students use and develop these skills in all subjects so that they understand their value.

These students also need much practice at developing and interpreting data in the form of graphs or tables. Again by taking a historical emphasis there is data that can be plotted over time and

analyzed for trends and correlations. So I look to incorporate graphs whenever I can in my course. By using them in this unit I am reinforcing their value and the students see the usefulness of this form of presenting data in a non- scientific application. Since I have responsibilities to cover a District wide curriculum and prepare my students for a standardized chemistry test, I can only devote two weeks to this unit.

The students will not have to find the information for themselves. In the interest of time and with a different focus in mind I would rather they appreciated the different sources that can be found. I hope the assignment will encourage them to decide on what information is of value. We will initially look at some background data together and then as they work in their groups I will ask the students to identify information that will help them and then I will try to locate the information for them.

To understand the issues involved around the air quality of Pittsburgh during the early 1900's, the students will form groups to represent each stakeholder. They will be presented with background material about the lives of their stakeholder so that they can present a position paper on behalf of their group. Then we would trace the progress and steps taken to improve the quality of air. As these are presented each stakeholder group will be asked to suggest how their group would have responded and what would be needed to obtain their cooperation. As we follow the progress of change I want the students to identify the critical success factors. The students will also account for the cost to their constituency, of the long delays to result producing changes. By accounting for the costs students will realize the value of a proactive approach to problems and start to demand that future consequences are sought for new technologies.

Finally the students will be asked to choose a current environmental problem and then identify the stakeholders involved and their concerns. The students will state where they fit in and what they, the students, are willing to do to help bring about a solution.

## **Objectives**

The students must read a series of documents, some stories, text- books and even newspapers of the day. Students will demonstrate their understanding and interpretation by being able to represent a stakeholder interested in improving the air quality of Pittsburgh in the 1900's. They will be able to describe the beliefs, the life and the concerns of these stakeholders. By having to represent a constituency the students will have needed to interpret the data and will not just be copying text from the materials. Of course they would much prefer to do the latter and so the unit is designed to make them work at a higher level.

Through this unit the students will produce and interpret graphs to reach decisions. As part of their presentations they will need to present data and explain its value to their presentation. The students will be encouraged to value data in supporting their arguments. As part of their assignment they will need to decide what data is needed to help their cause and then ask for it.

The students will be able to appreciate the difficulties of effecting change, and the co-operation needed. They will also understand that there are generally conflicting and equally valid concerns to any problem and that all groups generally have to make sacrifices. This will only happen if

everyone is committed to a solution. By identifying the issues of a current problem at the end of the unit the students will be able to demonstrate their understanding of these conflicts and recognize what part they are willing to play.

The students will also be meeting the Pittsburgh School District's Communications standards by making oral presentations, reading and interpreting various kinds of documents. They will also be meeting the science standards around science, technology and science. The data interpretation required for this unit is consistent with both math and science standards. See the appendix for a complete listing of all standards met.

## **Strategies**

The students will need a common understanding of the problem of air quality in Pittsburgh. So the beginning of the unit will be whole class activities and discussions to generate a common starting point. First the students will need to know what defines air quality and how it is measured. After this they will look at historical data of air quality and plot the trends over the time it has been collected. They will then be expected to analyze the data. For my students this is not a trivial exercise and a valuable experience for them. The students will then be asked to plot other data to seek correlation between the problem and other causes. They will examine population trends, industrial growth, coal consumption (both industrial and domestic).

The students will then need to answer the question " Why was the problem so much worse in Pittsburgh than in any other industrial city in America?" This will be a classroom discussion centered around Pittsburgh's location in a valley and its rich coal deposits. This will require a scientific discussion of air inversions and the chemistry of bituminous coal. One of the benefits of addressing a local problem is that the students will learn about their own environment and how it can exacerbate problems as well as present opportunities for local solutions.

Next the students will need to look at the effects of the problem in daily life. I would like to generate a bulletin board of photographs and newspaper descriptions to describe the problems in a broad sense. The photographs would be of the city, around the steel mills and around the homes of the wealthy. Also included would be photographs of poor homes, wealthy homes, inside the mills, worker groups and women and children. In 1906 there were a series of newspaper articles decrying the smoke pollution and these would also be on display. This graphic evidence is very powerful and the students' response should be "Why did anyone put up with this problem?" " How could it have lasted so long ?"

So why did Pittsburghers tolerate what would now be the intolerable? Again a local perspective will help students understand their inherited culture and the impact it had on historical problems. Joel Tarr suggests that "urban pollution can be understood as the product of the interaction among technology, scientific knowledge, human culture and values and the environment. " Pittsburgh was a city built on hard work and prospered with the success of the steel mills. The working furnaces were seen as a sign of prosperity and represented the hard labor of the community. Noted in Harper's Magazine, Dec 1880. "The true Pittsburgher gloried in the city's wealth and dirt. He believed that the great Iron City's mills and her wonderful furnaces are

inspiring even to the dullest." This tough, hard work ethic is part of the Pittsburgh culture and influenced the attitudes towards smoke pollution and its solution.

The location of many of the largest and smokiest mills was within a few miles of our school. To encourage a connection to the problems, I would provide the students with disposable cameras and ask them to find the locations in the historical photographs and take a current shot of the same locale. Students would be encouraged to find other evidence, positive and negative to illustrate the impact of the mills on the environment today. Students would also be asked if they could find family members to interview to provide statements about the air quality over time in Pittsburgh. Many may also have family members who worked in the mills and can provide first hand descriptions of the work and living conditions in a mill town.

The final part of this introduction to the nature of the air quality problem in Pittsburgh will be to understand why the problem was tolerated for so long. This discussion will involve a historical look at the priorities of a developing urban community. Clean water and a sewage system are the first priorities of a developing community. These 10<sup>th</sup> grade students are studying world cultures as their social studies course and this is an opportunity for them to realize the priorities that many third world countries are facing today and why environmental problems may be low on the list of priorities of people who have no sewage disposal, no clean water or health system. Students' amazement at the length of time it took to solve the air quality problems in Pittsburgh, is because they are looking at the problem from the advantage point of knowing that it *can* be better.

Now that a common understanding of the problem has been established, the next stage of the unit will be to break the students into five groups to represent: families, specifically the women and children in Pittsburgh; the steel mill workers; the mill owners; the politicians; a group of society ladies of the Pittsburgh Civic Club of Allegheny County. These were the stakeholders in solving of the air quality problem in Pittsburgh. The student groups will be given readings and data relevant to their group and will be asked to make an oral presentation to a commission trying to understand the problem. The purpose is for the students to try to see the problem from the perspective of the different constituencies. They need to identify for the group that they are representing: How the problem effects that group, propose a solution and identify what they are willing to do to make the solution viable.

I hope that through role playing the student assumes the passion and concerns of the group that they are representing. It requires a higher level of interpretation of information to see it through the eyes of someone else. It also shows that people can be exposed to the same information and interpret it differently. This suggests that perspective will always color interpretation and that as information seekers we must be wary of single sources and always try to understand the bias of the writer. This process also emphasizes the need to seek many sources and opinions. By having to compete to have their voice heard the students will try to build a good case for their group and care more about the project than if it was a written research paper. The competitive element means that the students will be more passionate about their presentations and feel the conflict that would have existed between the various constituencies.

It is difficult to find primary sources which are easily read by the students and which cover all the groups. I will create materials that represent key issues for each group. Some of the material

will be common to more than one group so that later on we can discuss how each group viewed this particular piece of information. These students find it difficult to imagine themselves in another place and time. To help them assume the concerns and passions of their group they will all need to be given some background information to use before they start to look at data through someone else's eyes. They need to empathize with their assigned roles.

This period of time was selected because it was the beginning of public awareness and concern for the air quality in Pittsburgh. It also marked a dramatic growth in industrial output and the subsequent population growth. Between 1880 and 1900, Pittsburgh doubled its population to be the eleventh largest city in the nation. It ranked fifth among US cities in the amount of capital invested in manufacturing, with more than half its assets located in iron and steel. It produced one quarter of the nation's iron and steel.

Another reason for selecting this time period is the rich information available, namely the Pittsburgh Survey, a remarkable document representing two years of research by Paul Kellogg of the New York Charitable Organization Society. This major study on life and labor in Pittsburgh during 1907 and 1908, was sponsored by the Russell Sage Foundation. The document came to symbolize urban industrial problems for all of America. This was a very readable document made public, with many of the findings gaining extensive newspaper coverage, both locally and nationally. The survey consisted of 6 volumes and these will form much of the data that students will use. These were *The Steel Workers* by John Fitch; *Homestead: Households of a Mill Town*, Margaret Byington; *Work Accidents and the Law*, by Crystal Eastman; *Women and the Trades*, Elizabeth Beardsley Butler; *Wage Earning Pittsburgh* and *The Pittsburgh District*, both edited by Paul Kellogg. This document demonstrates the value of an extensive research project. It also demonstrates how "infamous" was Pittsburgh's reputation for environmental problems. The document alone did not bring about change but it did begin public concern and start all stakeholders to look for and demand a solution.

Next the teacher will present what solutions were implemented and the process involved to bring about the solutions. As the class goes through this process the students will identify the "costs" to their group, what their group's reaction would be to changes. As part of the class discussion we will look at the role that technology played. As a group teacher and class will develop a list of success factors and barriers for improving the air quality in Pittsburgh.

Finally as a concluding activity and form of assessment, the students will select a current environmental problem. They will identify the stakeholders and the concerns of each stakeholder; they will propose barriers to solutions and the compromises needed to effect a change. The students will finally be asked to list what they are willing to do themselves. The students will work in groups based on the problems chosen.

## **Activities**

As stated in the strategies section, the unit will begin with the students using data to understand the extent of the problem and begin to develop a common understanding and background. The data to be used and the material to be presented is covered in that section. The analysis of data, response to bulletin board and scientific discussion of coal and geography of Pittsburgh should

take about four days. At this point the students will be divided into five groups to represent the interested parties: workers, their families; the owners; society ladies and politicians.

To help the students begin to identify with the group that they are representing, I will ask them to list the concerns of that group. What are the goals of the group and what influences those goals? I will then clarify those goals with each group of students and further clarify what they do understand about their roles and what information would help them better represent their stakeholder. After this one-on-one conversation I will then give each group, information to use for their presentation to the mock public hearing. This information will be in the form of simulated documents – reports, diaries, minutes of meetings, letters – to help the students get into their roles.

For the "*Steel Workers' Group*", the documents will cover the following points: In 1892, the steel workers' strike was crushed by heavy-handed tactics of the companies. Improved technology and mechanization eliminated most of the skilled jobs and left the demand for more unskilled labor that was paid at extremely low wages. Immigrant workers were arriving everyday and were willing to work so that they could get a start in America. The wage though was so low that it could not support a family. The men worked 12 hour shifts for six or seven day weeks. The shifts alternated between daylight and evening so any sense of time was lost. The work was extremely hard and the conditions extreme. The dirt was everywhere and the heat and glare from the furnaces overpowering. Summer months were worst when many men were overcome with heat exhaustion. When their shift was over, they were only too happy to go home and rest. Sometimes they switched beds with the boarder who was just leaving for the next shift.

The work was dangerous and the number of work related accidents and deaths high. The men worked with knowledge that they might die that day. Many accidents left the workers permanently maimed and unable to work. There were no disability payments and so the family was without income. Along with the danger on the workplace was the uncertainty of employment. The employment matched the orders for steel and if demand was low then the workers were laid-off. They rarely had twelve months of employment and could not predict the down times of unemployment. During the periods of unemployment, loans were needed to see the families through. So the low wage which was barely enough even during employment had to be stretched further to repay debts incurred during unemployment.

As the companies expanded the number of workers increased and the familiarity with the supervisors disappeared. After the bitter strike and the ruthless actions of the owners the workers were wary of company spies and tended to just work and talked little amongst themselves. Again their exhaustion at the end of the day often discouraged further socializing among themselves.

The "*Workers' Families Group*" will be given scenarios to cover the following points: With the constant influx of immigrants the demand for housing was high. Workers could afford no transportation and so had to live within walking distance of the mills. There was no escaping the dust and smoke. The houses were small and very close together. Often there were 2 or more people to a room. To supplement the low wages, families took in boarders who might alternate a

bed and shift with another family member. There were no jobs for women so they were confined to the home where the grime and fallout from the mills meant constant cleaning. Clothing and curtains etc wore out due to the constant cleaning. When a weary father came home from the mill he was too tired to help with any household chores or even spend much time with the children. There was very little family interaction. The family had to adapt its schedule to the shifts worked so that the father could sleep. Children were often ill and mortality high amongst children. Households had to adjust to lay-offs and cut back on expenses. This often meant that the children and mothers ate little to provide the wage earner with a meal. There were large numbers of people living in very small areas without sanitation or trash removal. There were no gardens, just mud, trash, outside privies and no municipal collection. There were the families whose husbands had either been maimed or killed in industrial accidents and now lived on the charity of the community.

For the "*Society Ladies Group*" documents will be provided to cover the following points: Many of the wealthy families were able to move away from the city where the mills were located. But when the steel industry expanded, mills began to appear in the suburbs also. Still the society ladies were removed from direct contact with the mills and did not immediately feel the dirt and heat. They were able though to see the smoke filled sky and their gloves got dirty and the children would come in dirty from playing outside. The dirty clothes were taken care of by servants, but the association of dirt with disease was such that these ladies felt concern for their children's health. They also felt that if the children of the workers became ill then their own children were at risk. These women had a lot of leisure time and a need to be of use so they would meet with one another and focus on a problem. Such a group formed in 1889 calling themselves the Ladies Health Protection Association. These women had an opportunity to travel and visit other cities that were not so tolerant of such filthy conditions. Their husbands were successful but they also wanted to belong to an important and enviable city. The population and wealth of the city should have made it more prestigious but the smoke gave a different kind of notoriety. For a few years in the 1880's a local source of natural gas had been found and used. This had set a precedent for cleaner air. These mothers also felt that the children of the poor would adjust to dirt and this would impact the morality of the city and their own children. So it was with a sense of moral duty that the ladies fought for clean air.

The "*Mill Owners Group*" will review the following information: In 1892 the mills successfully squashed the first attempt by labor to organize. After a very bitter and violent confrontation the strikers were defeated. The mill owners wanted to maintain their power and were unwilling to concede to any worker complaints. By advertising in Europe there was no shortage of workers. In fact immigrant workers had fewer work options and the language barrier made them easier to control. They were generally from autocratic societies and respected authority. The owners invested to expand the mills even though there was an overcapacity. In order to maintain profits it was essential to keep costs low. Coal the main contributor to the smoke was a local and cheap source of fuel. In fact the industry had grown because of the availability of coal. There was really no other source of fuel available. The prosperity of the region was due to the steel industry and reduced profits would have a negative impact on the region. By 1900 the owners had left the area and moved to New York. They no longer saw or experienced the problem for themselves.

The "*Politician Group*" will be given documents to cover the following information: Christopher Magee was the Mayor at the time and established an era of corrupt politicians willing to sell favors for monetary and political gain. Magee profited greatly with the sale of land to the Steel Mills while they were expanding. The Mill owners in turn were able to coerce votes from the workers and so expected their interests to be protected. The industry of Pittsburgh was a source of revenue for the city, through taxes from both workers and owners. City Council had already shown its concern for the problem by passing a smoke abatement ordinance. The smoke did impact the real estate prices in the city itself, making it a less desirable location. The rich preferred to live further out to avoid the smoke. Thus the city tended to have a higher concentration of poorer families. Public buildings were also damaged by smoke and were more costly to maintain. Adverse publicity from local newspapers, national magazines and the Pittsburgh Survey promoted a negative picture of Pittsburgh. Pittsburgh had a national prominence due its heavy industry but did not want to be equally well known for its pollution. There was no hard evidence linking smoke pollution with illness.

As the students present their arguments, the teacher will keep a chart of the different "facts" presented and we will decide if all groups knew these "facts" or interpreted them differently. For instance dirty clothes to a society lady would represent a nuisance and a possible health hazard, where as a worker's wife would see it as yet more work in an already strenuous day. This is to emphasize that "facts" change with your point of view. We will also keep a chart of why each group may want the problem solved or why they would be opposed to it. For each group a list of priorities will be developed to identify the importance of the issue and what may need to be addressed before that particular group will be willing to begin problem solving. Included on this chart will be the issues that must be addressed to gain each group's cooperation. As the class reviews the long process to the final reduction of the problem they will note how the concerns of each group was met.

The final reduction of smoke in the Pittsburgh area did not happen until 1950, almost 50 years later. There were two World Wars to divert attention from local problems, the Depression and a list of more life threatening issues before the smoke pollution would be addressed. Finally, if Pittsburgh was to compete with other large cities as an industrial city then it would need to meet higher living conditions. Over those fifty years industry had made some improvements so that when the decision was made to finally solve the problem it would be a lot more complex as it would involve shifting attention to domestic and transportation (mainly rail) use. The final solution required all parties to change to either a smokeless fuel or change the form of combustion of fuel. Either method meant increased expense to all concerned.

What were the elements of success? First it took a few highly committed individuals to maintain the pressure for a solution and to motivate people whenever an obstacle was encountered. The solution required a change in attitudes and practices. There was an ongoing public awareness and education process from the leading newspaper and women's civic groups. Again the commitment of individuals willing to assuage fears on a one-on one basis was critical for gaining public support for a solution and education for the successful implementation. The public also provided the stimuli for real political action. Technical expertise was sought to both clarify the

problem and generate solutions. Their findings were also made available to the public and in language appropriate for the general public. As alternative solutions were sought, they were always reviewed by considering both the impact on industry and the poor. To make sure that all constituencies were included and knew that they were included, public meetings were held. This inclusion was novel for the time. Enforcement of domestic use had always been a problem and this time aggressive enforcement was applied at the distribution points. This proved to be much more efficient and successful, especially as the government was not seen as denying heat to low income families. The availability of cheap, clean natural gas finally reduced the last of the smoke. The problem was solved when it became a priority for everyone. The process is as relevant today in that a sincere effort was made to include all constituencies and meet their concerns.

Carnegie Mellon a local University is conducting an extensive national research project to test air monitoring equipment and processes. The laboratory and equipment is located in Schenley Park close to our school. I have spoken to the program director and this facility is available for tours. I would like to take the class to visit this facility to learn about the testing that is possible and the results obtained so far. This will give the students a complete picture of air quality in Pittsburgh today.

Finally the class will form groups around local environmental issues and through small group discussion list the major stakeholders, their hot buttons, their barriers to a solution. Then each of them individually will write a description of what they think they personally could commit to do to make a difference. We would write these up as contracts and examine them later in the school year.

Another possibility is to just examine the energy issue. The dwindling energy supplies, is and will continue to be a problem. It is an issue similar to the air quality problem, in that it will take a large public awareness campaign, changes in energy uses and attitudes for all, and a coalition of many interest groups.

I also teach a gifted class and a requirement for this program is that each student must carry out some independent research and present it to a group. I would like to involve this group in producing the "documents" which are used during this unit to develop the "point of view" of each constituency. These students are creative and sophisticated researchers. Their involvement will produce great documents but also make them aware of the issues and the history. Without spending as much time on this particular unit but using it as an illustration in other units that we study, I would still like the gifted students to make similar contracts as the other chemistry classes.

Hopefully, at the end of this unit the students will have a greater appreciation of the complexity of environmental problems and the generation of solutions. But despite the daunting barriers to solutions, students will now feel both a commitment to solving the problem and contributing to the solution.

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## APPENDIX

This unit will address the following Standards of the Pittsburgh Public Schools:

1. Science and Technology Standard #4. All students explain the relationships among science, technology and society.
2. Science and Technology Standard # 7. All students evaluate advantages and disadvantages and ethical implications associated with the impact of science and technology on current and future life.
3. Communication Standard #2. All students read and use a variety of methods to make sense of various kinds of complex texts.
4. Communication Standard #3. All students respond orally and in writing to information and ideas gained by reading narrative and informational texts and use the information and ideas to solve problems.

5. Communication Standard #4. All students write for a variety of purposes, including to narrate, inform and persuade in all subject areas.

6. Communication Standard #5. All students analyze and make critical judgements about all forms of communication, separating fact from opinion, recognizing propaganda, stereotypes and statements of bias, recognizing inconsistencies and judging the validity of evidence.