



## Engineering Design Mission Folder Score Range – 301-400

### Team Collaboration

**How was your team formed? Was your team assigned or did you choose to work with each other?**

Team 4 all decided to work together because team 4 is interested in the environment and thought that the team members individual talents would work well together. Team member 2 is good at researching, Team member 1 is good at graphs, and some of us are even good note takers. These talents all make up a good team that will do well on the project.

**Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.**

Team member 1 is our handler for our charts and graphs. Team member 2 is our material handler. Team member 3 keeps track of our data, and Team member 4 will take notes on the experiment. Team 4 will work together on the folders but divide it up so everyone can help equally because everybody needs to play an equal part in making this project. If all the team members do their equal share the project will turn out as plan.

**Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?**

Some of the problems team 4 faced are that it took a large amount of time to find the problem that the team was going to solve and the solution to it and another problem is that we got off-topic some of the time. Furthermore, one other major problem is that we met up later than expected, yet we still got a great amount of work done. Although we had a few problems, we eventually found a problem in the community and started thinking of some good solutions to solve it.

**What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?**

Working as a team on this project made this project easier by creating more ideas and helped team 4 to realize the mistakes. The mistakes that we made on this project helped us to be better in the future. If we had worked individually, we would not have not gotten as good of a result. Working individually means that there would be less ideas that could be made and shared.

### Use of Engineering Design

What problem in your community will your team attempt to solve using the engineering design process? Team 4 will be addressing high lead levels in schools drinking water. During this project Team 4 will try to identify, analyze and find solutions to reduce the lead levels. This has become a big problem in the recent years for many areas. Team 4 plans to shed light on areas that have been affected by this issue other than the ones we already know (Flint, MI water source). With the research found from different sources, Team 4 will design and build an alternate system that may be helpful to this issue. Team 4 will address

many items that can reduce these lead levels.

**Research your problem. You must learn more about the problem you are trying to solve and also what possible solutions already exist. Find AT LEAST 10 different resources and list them here. They should include books, periodicals (magazines, journals, etc.), websites, experts, and any other resources you can think of. Be specific when listing them, and do not list your search engine (Google, etc.) as a resource.**

There are many different resources that Team 4 has found that will help identify the areas that have been affected:

- \*Epa.gov (website)
- \*May O Clinic.gov (website)
- \*Portland Oregon.Gov (website)
- \*CDC.gov (website)

Others have given Team 4 about how many and how large this issue is to our United States:

- \*USA Today (newspaper)
- \*The Tennessean (newspaper)
- \*The Pacific Standard

The rest will shed light on how to fix this issue:

- \*Channel 5 (news channel)
- \*Fox 13 (news channel)
- \*Fox 17 (news channel)

With the research from these different sources, Team 4 should be able to identify, analyze and find a solution to the high lead levels in schools drinking water.

**Explain what you learned from your research. What did you find out about your problem that you didn't know before? What kinds of possible solutions already exist? Be sure to put this in your OWN words, do not just copy and paste information. Also, be sure to cite your sources.**

From cdc.gov, Team 4 learned that cold water is better to drink than hot water because hot water dissolves lead faster. This site also helped this team learn that a great way to maintain the cold water is by wrapping carbon fiber around the pipes. On the website protlandoregon.gov, this team learned that boiling water doesn't get lead out of water, cold water does. The mayo clinic informed this team of some of the symptoms such as hearing loss, vomiting, seizures, constipation, and fatigue. Team 4 learned that corrosion was a cause of lead water on epa.gov. In one school there is a drinking fountain with 5,000 ppb, parts per billion, on USA Today and the school is drinking waste water. On Channel 5, this team learned that it isn't a law to test lead in school water, but there is a bill that is trying to be passed. It is called the Legislation Bill. Health.state.mn.us told team 4 some possible solutions that already exist. For example, the flush system, which can help to get some of the lead out of the water before you drink it. Fox 13 and Fox 17 informed the team that over 4000 samples were found that showed a high lead level and some schools will be forced to find a new water source. Pacific Standards enlightened the team that over 13,000,000 kids went to school last year where there was more than 15 ppb of lead in the water. Lastly, the Tennessean told team 4 that many organizations hide their findings about lead in water to prevent chaos.



**What MUST be a part of your solution? This is called the criteria. What does your solution need to have in order to solve the problem? (NOTE: Don't discuss a specific solution here, just the characteristics of a good solution).**

Through a lot research we have realized that we will need following to address this issue of high lead levels in schools drinking water:

\*Samples from various schools drinking fountains. Since schools have many drinking fountains Team 4 is going to attempt to test the one that is used the most.(Hallways and Cafeteria)

\*A new pipeline / plumbing system. Team 4 will be using PVC piping for this portion. The is the most cost and labor effective.

\*EPA testing lab. Since they have banned the use of lead pipes in homes, the most accurate way to test for lead is a high quality testing facility. In the recent years homes have found that generic test strips don't give the best result.

**What limits are there on your solution? These are called constraints. Does it need to be a certain size? A certain weight? Is the cost a factor? Write down all of the limits on your solution.**

Team 4 found that there are all type of constraints to this solution and a lot of unknowns. Cost is one of the big ones. There are cost for everything....Cost of piping, labor cost and testing cost. Although the cost of the PVC is about \$2.20 per 10' 1/2, it is the part of getting tested. That is where time comes in. Team 4 found in one article that if the lead level is too high, they will shut down the school.That means that many can lose their job.It takes anywhere from 7 days to 30 days to get true results from a lab, and that also cost money. That is where cooperation comes in. People send their kids to school thinking they will be safe. Can you imagine what would happen if the parents found out the levels were to high. This is why this has become a huge issue. Nobody wants to start the process and see where the levels are.

**Based on your criteria and constraints, what is your proposed solution to the problem you chose? Explain what it will look like and how it will work. If you can, include a detailed, labeled drawing.**

Based on the criteria and constraints, Team 4 found the best way to help this issue is change the solder joints, valves and piping to PVC for the last 20' for each drinking fountain. Research tells us by changing these pieces you will reduce the lead levels. Also, you must have a proper cooling system attached to drinking fountain. Research tells us that cooler temperatures of water also reduce lead levels. Lastly, for best practice flush fountain for 1-2 minutes before drinking. With these 3 systems in place lead levels should reduce a lot. That narrows down if it is the school or the source that the water is coming from, which then it is on the government.

**How will you test your solution? The BEST way to test your solution is to build a working model or a prototype that you can actually use. Or you can guess how your solution will work BASED ON your research. Which method will you use and why?**

Team 4 will build a mock water fountain. Team 4 will use PVC piping, solder joints and valves, because research says metal will corrode and still give a high lead level reading. This is also the most cost and labor effective for the Team.

**If you built a prototype or model, explain how you built your prototype or model, step-by-step including all safety precautions. If you guessed how your solution would work BASED ON your**

**research, explain important information from your research that you used to prove how your solution would work and be sure to cite your sources.**

Team 4 went to Home Depot and found an employee in the plumbing section. Team 4 showed him the drawing to the prototype. The employee then directed us to the parts needed.

- \*10' PVC pipe
- \*2 solder joints
- \*2 valves
- \*pipe brackets
- \*funnel

Team 4 had the employee to cut the 10' PVC pipe in:

- \*2-24" pieces
- \*1-12" piece
- \*1-6" pieces

This is actually a reverse fountain because of no water pressure.

Team 4 connected the 2 24" pieces to both solder joints (one going up, the other going down). The a valve on either end of the 24" pieces. (To stop and start water flow). The solder joint going up, connected to the 12" piece of piping and funnel. The solder joint going down connected to the 6" piece and valve. Creating this prototype should reduce the lead levels, however with the other systems in place it should reduce even more.

**Explain how you tested your prototype or model. Be sure to include every step of your testing including all safety precautions that were taken. If not stated it will be assumed no safety precautions were taken. If you are using research to guess how your solution will work, explain step-by-step how it will work and why.**

Team 4 collected samples from 4 different schools in the Memphis Tennessee area. Based on research Team 4 wanted to test these samples by pouring and running them through prototype. For Team 4 to do so, the most effective way would be to send 8 samples (before and after ) to Professional Laboratories Inc in Ft Lauderdale, FL. This would cost about \$250. Since this is a huge issue Team 4 thought that would be the best way. We did not send the samples off. However, Team 4 did run the samples through the prototype, just no data. Through research, it does not give specific numbers that the levels should reduce by, due to the different areas and water sources.

**What problems did you find with your solution? Be specific since you will need to redesign based on these problems.**

The problems Team 4 were not design problems but more variables. The water source, how old is the school, the sample collection device, etc. Team 4 still believes with these systems in place, the lead levels will reduce a lot.

- \*New piping system
- \*Flushing for 1-2 minutes before drinking
- \*Properly cooling the water in the system.(drinking fountain)

**Describe all of the changes you made to your prototype or model (or proposed prototype) after your first test. Why will these changes improve your solution?**

There were no changes made to the prototype. The prototype did not have any faults the first time. The test worked perfectly and it proved to be useful.



**Present the data you collected from your tests or from your research. If you tested a prototype or model then include all of the numbers you gathered during your testing and all observations you made. Use of graphs and charts is HIGHLY encouraged. If you used research to prove how your solution would work, be sure to include all of the numbers, charts, and graphs you used to make your case.**

From the research team 4 took, the team can prove how the team's solution would work. Knowing that using non-metal pipes would mean less corrosion, less corrosion is less probability of contaminated water. Also, cold water makes lead dissolve slower than hot water so that would mean the drinking water would need to be cold. Some other important things that would affect the solution are if the water has been exposed to any chemicals, whether it is flushed or not, and more. The solution would work according to this.

**What are your potential sources of error? Remember, this doesn't mean "Did everything work?", all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.**

Some potential sources of error are the different types of pipes that could be used. Team 4 decided that PVC piping was the most cost and labor effective, but could not figure if this was the best solution. Copper is a metal that could potentially keep the water colder and will not corrode. Another potential source of error would be the containers that the samples were collected in. Could the collection containers have lead in them already,?

Where they flushed properly before collecting samples? Even if Team 4 was able to actually test, these errors may have altered the outcome of the result.

**What conclusions can you draw based on the data you gathered during your tests?**

The conclusion that Team 4 has gathered from this project is, this is a much bigger issue in the World than expected. Symptoms that are related to a "stomach bug", could actually be high levels of lead in the drinking water. Learning disabilities may be more due to high levels of lead. High levels of lead affects children more than adults. The EPA banned the use of lead pipe a long time ago in homes, but not in schools. Kids drink more water at school than they do at home. High levels of lead in schools drinking water is bad and no one can come with a clear way to fix it. Schools want the government to do it, the government wants the schools to do it and the kids keep getting sick.

## **Benefit to the Community**

**Explain how investigating the problem your team chose will help the community. Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.**

The problem we are trying to solve to help the community will reduce lead in school water. We think that older schools may have lead pipes, which is bad because it will harm the person who is drinking that water. It could prevent some symptoms such as a stomach bug, headaches, and anemia. Other effects include pain in areas like the abdomen or joints and gastrointestinal, which is constipation, nausea, and vomiting. Sadly, it can also cause permanent damage to the brain.

## Abstract

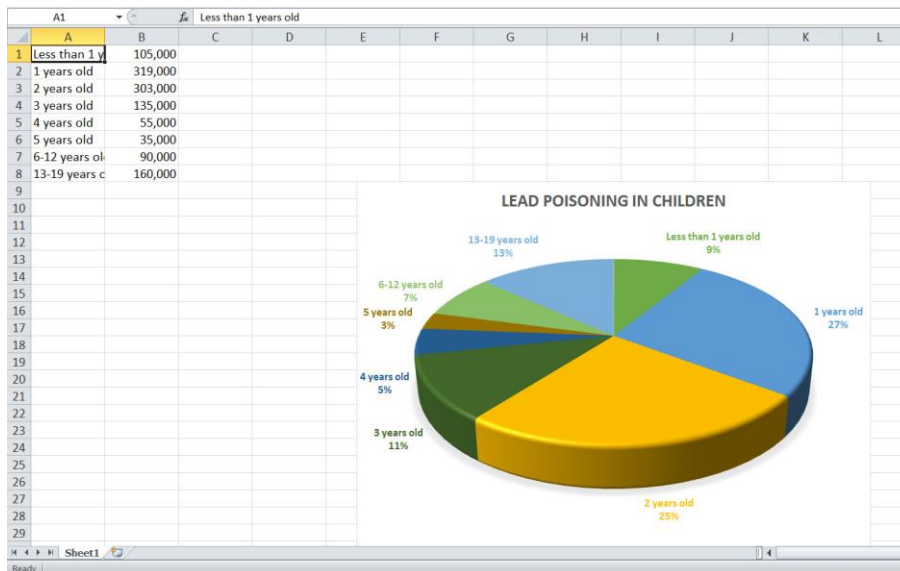
First in team 4's project was the selecting stage. The team needed to pick whether the team would do scientific inquiry or engineering design and their topic. The team's topic was environment and the team was going to do engineering design. The next step was finding what problem in the community the team was going to solve. One of the problems that looked interesting to the team was reducing water pollution. This would help the community in a variety of ways. For example, it would help reduce the number of aquatic organisms that die because of this. It would also help humans if the humans drank contaminated water which could cause typhoid, cholera, and various other diseases. The team had settled on testing for lead in water. During the team's research, the team found out many things about lead. One website informed them that the normal amount of lead is 15 parts per billion. Another informed them that a school had over 5,000 parts per billion of lead in the school water fountain so the school was drinking very contaminated and dirty waste water. The team also found out many other things during the research. Then after research came the stage of creating the model which included PVC piping, solder joints and valves, because research says metal will corrode and still give a high lead level reading. Overall, the project turned out to be a success. The team had a few struggles, but team 4 eventually fixed them.

## Attachments

File #: 1

Title Lead Poisoning In Children

Description - The file includes a chart of the amount of kids that have lead poisoning from the research that team 4 found.



File #: 2

Title Pictures along the way

Description Here are some pictures that Team 4 took along the way.

## Pictures along the way



This is the reverse plumbing system.



This is a water sample from a local preschool called Lord of Life (left) and a water sample from a elementary school named Balmoral Ridgeway (right).