LATHROP ENGINEERING

Name:

UNIT 5: WATER PURIFICATION

Engineering, Design & Development (Senior Design) Unit Due Date: **November 27, 2019**

Our fifth unit is all about the engineering design process – as our whole semester has been – with a focus on the test and evaluate step. Here, you'll be tasked with creating a water purification system that can clean up some dirty water using a filter that you construct. Part of the challenge will be making a system that fits within your budget constraint, meets the requirements for timing, and can produce a cleaner water with lower turbidity. In the end, the expectation is that you learn the following:

- How to use the engineering design process to tackle a very specific problem
- How to read a design brief and work within given constraints
- How to create and test various solutions before objectively choosing a "best solution"

As we move through this unit, you are responsible for making adequate progress through the assignments, and for being done by the Unit Due Date (**November 27, 2019**). You are also responsible for completing each part before moving on to the next. Our unit is broken up into two main parts:

Part 1: **Water Purification** *(100 pts) Approx. 8 days*		
This project is designed to make you work within specific constraints to solve a real-world problem: water purification. You'll need to do various testing with materials and processes before settling on a final solution. Your final solution will need to be able to filter 100 ml of clean water in only 10 minutes. To do so, you'll need to create a filtration system within budget constraints to impact both the clarity (turbidity) and the pH of the water sample. As you build your filter, you'll need to document your engineering design process. You'll make a variety of test filters, use a decision matrix to choose the best one, then create your final filter for official testing!		Design Brief
		Build & Test Prototypes
		Decision Matrix Notes
		Decision Matrix
		Develop Final Solution
		Document Engineering Process
		1-Page Reflection
		Check-off from Mr. Benshoof
Achievement: Make a filter that meets ALL criteria and constraints including deadline!		

Part 2: **College Tasks** *(20 pts) Approx. 3 days**		
For these next few units, you'll be writing some scholarship essays that will help complete applications for various scholarships later next semester. By getting them done now you'll have time to edit them, and you'll be setting yourself up for an easy application season in the future. Take your time on the essays, but don't get behind because there will be more coming up each unit!		Scholarship Essay #3
		Scholarship Essay #4
		Check-off from Mr. Benshoof

(100 pts) Approx. 6 days

This unit is all about using the engineering design process to solve a very specific problem, while working to stay within very specific constraints. The challene in this unit will not only be collecting enough data to make informed choices, but making sure that your solution fits within budget constraints and time constraints, and that you meet both pH and turbidity criteria. Developing a solution with such tight parameters is a challenge, and will require a lot of materials testing, communication, and planning.

PROBLEM SCENARIO: *People around the world need clean drinking water. In some parts of the world it is very difficult for people to find clean water for drinking and cooking, and so they are forced to use unclean water. This is a problem because when people regularly consume unclean water they can get sick, and when large groups of people are all getting sick from unclean water it creates serious humanitarian problems. A solution is needed for filtering unclean water so that it is safe to drink. For the purpose of this study, we will measure pH (ideally 7) and turbidity (ideally 0 NTUs).*

You will be given 1 gallon of unclean water to use for ALL of your materials testing, prototyping, and final demonstration – so plan carefully! You will need to use the available materials to test and develop a filtration system. In the end, your final filtration system needs to cost less than 100 engineering dollars, be able to filter and produce at least 100 ml of clean water in 10 minutes, and get the turbidity as close to 0 NTUs as possible as well as get the pH as close to 7 as possible.

1. To start, put together a design brief for the problem. Make sure that your design brief is complete, that it includes all the parts necessary for a complete design brief, and that you emphasize the criteria and constraints for the problem.
2. Next, look at the list of available materials and their associated cost in "engineering dollars". Brainstorm a variety of possible filtration systems and setups that you might be able to make. *Record your brainstorming with pictures!*

Filter Paper ($30)	*Charcoal Briquette ($30)*	Sand ($15)	*Potting Soil ($10)*
Paper Towel ($10)	Cotton Balls ($2 ea)	*Sponge ($15)*	Felt ($20)
Plastic Bottle/Tubing/Equipment ($30 for the setup)		*Special Bonus Materials TBA ($25)*	

3. Next, conduct some materials research to understand your materials better! Figure out how wuickly water can travel through different materials, how the depth of the material impacts the results, and how each material impacts the pH and turbidity of the water. Be careful not to use up all of your test water! As always, record your results and share them with your fellow Senior Design students!
4. Make a written plan (including a picture) for a first prototype of your filter.
5. Build your first prototype and see how well it works. Get feedback and record your success/failure with this first prototype.
6. Make a written plan (including a picture) for a second prototype of your filter.
7. Build your second prototype and see how well it works. Get feedback and record your results!
8. Make a decision matrix to evaluate the different materials and your prototypes. Use the results of the decision matrix to inform your final design.
9. Make a written plan and picture for your final design. Make sure that your final design costs no more than 100 "engineering dollars"
10. Test your final design to see if it:
    a. Creates 100 ml of clean water in no more than 10 minutes
    b. Gets the pH as close to 7 as possible
    c. Gets the turbidity as close to 0 as possible
11. Draw a picture of your final solution and write a 1-page reflection on the entire process, what worked, and what didn't.

Part 1: Exploration Tasks		*10-8 points*	*7-5 points*	*4-0 points*
Design Brief		+ You created a complete design brief that details the entire water purification task	- Your design brief is missing some elements	- Your design brief is missing many elements
Brainstorming Notes		+ You took detailed notes brainstorming different solutions + Your notes include pictures of possible systems	- Your notes do not include pictures - Your notes are superficial	- No notes about brainstorming
		8-7 points	*6-4 points*	*3-0 points*
RESEARCH & EVALUATION	Materials Testing	+ You conducted materials testing on all the materials you thought were worth looking at + Your materials testing was used to inform future decisions	- Your materials testing was very brief - Your results were not clearly used later	- No notes
	Materials Notes	+ You took good notes on your materials testing + Your notes are well organized and shared with others	- Your notes are overly brief - Your did not share your notes with other seniors	- Your notes are totally missing
	Build Your First Prototype	+ Your first prototype is assembled completely + Your prototype follows your plan	- Your prototype is noticeably incomplete - You did not follow your plan	- Your prototype is missing - You did not follow your plan at all
	Build Plans	+ You have written plans for each of your prototypes + You recorded results and feedback from each of your prototypes	- Your records from your prototyping and work are incomplete	- Your plan is missing - Your plan has no picture
	Build your Second Prototype	+ Your second prototype is assembled completely + Your prototype follows your plan	- Your prototype is noticeably incomplete - You did not follow your plan	- Your prototype is missing - You did not follow your plan at all
		20-15 points	*14-10 points*	*9-0 points*
Decision Matrix		+ You made a complete decision/evaluation matrix to assess your different material options + Your decision/evaluation matrix emphasize the criteria and constraints	- Your decision/evaluation matrix is missing some parts - Your decision/evaluation matrix does not address all of your filtration system options	- Your decision/evaluation matrix is missing many parts or is very incomplete
Final Filtration System		+ Your final product is well built + Your final product meets the constraints + Your final product meets the criteria as best as possible	- Your final product is not fully built - Your final product does not quite meet the criteria or constraints	- Your final product is incomplete/missing - You missed most/all of your criteria & constraints
Achievement		+ Make a final filtration system that successfully meets all budget and time constraints as well as pH and turbidity criteria by the unit deadline!		

(20 pts) Approx. 3 days

For the remainder of our semeseter, the college work will focus on writing essays for future scholarships. During the spring semester, there are a wide range of scholarships that we'll apply to. Historically, Lathrop Engineering students do very well with these scholarships, and I think a large part of that is that we write the essays early on so that while your peers are stressing over scholarship applications, you can simply spend time putting things in envelopes. Good work and preparation now while your schedule is a little less hectic can make for great success next semester.

THINGS TO THINK ABOUT WHEN WRITING SCHOLARSHIP ESSAYS:

1. ***Spelling & Grammar Count!*** As you write your essays, pay attention to the quality of your writing. You should be writing as well as you would if you wanted to impress Ms. Bouta, Mrs. Robinson, Mr. Stoddard, and Mr. Brown. You've had a great writing education here at Lathrop, and now's the time to flex those muscles. *Write well*, and give yourself time to edit and revise.
2. ***Word Count Counts!*** If a wealthy donor wants to give money to college students, they want to give it to a college student that *cares*. To demonstrate that you care, you should always be within 95% of the allowed word count.
3. ***SCHOLARSHIP ESSAY 3:*** UAF/UA gives out a huge amount of scholarship money to incoming students that are active in school and their community. Below is the essay prompt for one such scholarship:

   UA Activities Scholarship (475-500 words)
   "Tell us about your activities outside of the classroom. This could include things like volunteer work, sports, clubs, leadership roles, family activities, hobbies, employment, or cultural activities."

4. ***SCHOLARSHIP ESSAY 4:*** UAF/UA also give out a large number of scholarships to people that have clear goals for where they are headed, students who have a significant challenge getting to where they are now, and people that have accomplished a lot in high school. Below is the essay prompt for one such scholarship:

   UA Individuals Scholarship (475-500 words)
   "Tell us anything else that you would like the scholarship selection committees to consider when evaluating you as a scholarship candidate. This could include things like your financial situation, your family or cultural background, *honors and awards you have received*, challenges you face or have overcome, *personal accomplishments*, or anything else you believe is relevant."

Part 2: College Tasks	*10 points*	*5 points*	*0 points*
Scholarship Essay 3: *"UA Activities Scholarship"*	+ You wrote a good scholarship essay that was between 475 and 500 words + You had Mr. Benshoof edit your essay	- Your essay was outside of the word count - Mr. Benshoof did not edit your essay	- Your essay is missing
Scholarship Essay 4: *"Engineering Interest"*	+ You wrote a good scholarship essay that was between 475 and 500 words + You had Mr. Benshoof edit your essay	- Your essay was outside of the word count - Mr. Benshoof did not edit your essay	- Your essay is missing