PROJECT OVERVIEW

Teacher team	Austin Batson, Kira Lowery, Pooja Patel		
Name of Project	Can I drink it?	Duration	5 class days
Subject/Course	Environmental Systems	Grade Level	12
Other subject areas to be included	Basic chemistry ideas so that students understand how water tests work		
Project idea: Summary of the challenge, investigation, scenario, problem or issue	Students will design a water filter out of basic materials (water bottle, sand, gravel, charcoal, coffee filter/cheesecloth). Students will then travel to different natural water sources in Austin to collect and test water for various pollutants (pesticides, nitrates/nitrites, iron, bacteria) . After building their filters, they will test the previously collected water for the same pollutants and compare the before and after results. Finally, students will compare their filters to others and make conclusions about why certain filters produced different results.		
Driving question	How can I make water safe to drink?		
Entry event to launch inquiry and engage students	Anchor Video		
Content and skills standards to be addressed	(9) The student knows the impact of human activities on the environment. The student is expected to: (A) identify causes of air, soil, and water pollution, including point and nonpoint sources; (B) investigate the types of air, soil, and water pollution such as chlorofluorocarbons, carbon dioxide, pH, pesticide runoff, thermal variations, metallic ions, heavy metals, and nuclear waste; (C) examine the concentrations of air, soil, and water pollutants using appropriate units;		
21st Century skills		Taught?	Assessed?
*Collaboration	Students will work in groups of 3-4 throughout their projects. They will work as a group to research pollutants, design and build a filter, collect and test water, investigate other group designs/results and redesign, and present their final results.	Students will have to assign group roles	There will be a team evaluation at the end of the project
*Presentation	During the final day, students will present their filters, water quality results, and analysis of the success of their filter. The presentation should include quantitative data about their filter as well as comparisons to other groups.	No specific presentation skills will be taugh	Students will be evaluated according to a presentation rubric

*Critical Thinking	Throughout the project, students will use their critical thinking skills to determine the source of pollution, how to best filter it, and how to improve their filter	Instructions will be given to guide students to the questions they need to answer	Work will be completed on worksheets that will be collected and graded

Culminating products/performances	Group: The group will present their water filter, the pollutants they tested for, the predicted sources of pollution, and future improvements to their water filter	Individual: Each member of the team will be responsible for speaking during the presentation	Audience: When not presenting, each group will take notes on the presentation

Formative Assessments			
Quizzes/Tests		Practice Presentations	once, Mon
Journal/Learning Log		Notes	Each day
Preliminary plans/Outlines/Prototypes	Each day	Checklists	Each day
Rough drafts	Wed	Concept maps	
Online tests/exams		Other	
Summative Assessments			
Written product (with rubric)	Tues	Other product (with rubric)	
Oral presentation (with rubric)	Tues	Peer evaluation	Mon, Tues
Multiple choice/short answer test		Self evaluation	Tues
Essay test		Other	

Resources Needed		
	Description	Source
On site people/facilities	Buses, Colorado River, Walnut Creek, Walter E. Long	
Equipment	LabQuests; temp., nitrate, ammonia, pH probes; various-sized bottles;	
Materials	(on materials sheet in packet)	
Community resources	Field trip days	

Reflection Methods			
Journal/Learning log	Every day	Focus group	

Whole-class discussion		Fishbowl	
Survey		Other	

Unpacking the TEKS

(9) Science concepts. The student knows the impact of human activities on the environment. The student is expected to:

(A) Identify causes of air, soil, and water pollution, including point and nonpoint sources;

Student's prior knowledge needed: Students will need to be able to

- Describe an ecosystem
- Predict how a disturbance to one aspect of an ecosystem can affect others
- Identify, describe and locate pollutants in an ecosystem
- Define pollution
- Have general background knowledge on sources of pollution (cars, littering, power plants)
- Draw connections between different parts of an ecosystem

Teacher's Background: The teacher should

- Be familiar with (be able to describe) several causes and sources of pollution
    - Cars, littering, runoff, pesticides, power plants, etc
- Help students establish a general framework from which students can identify and test pollutants

- Provide students the means to collect and test water samples for pollutants
    - Bacteria, lead, pesticides, nitrates/nitrites, chlorine, hardness, and pH
- Be able to identify, classify, and predict whether a pollution source is point or nonpoint

What students need to understand? Students need to understand...

- The consequences of pollution on an ecosystem
    - How one type of pollutant can have a ripple effect through an ecosystem
- The sources of different pollutants
    - Industrial, farm, city…
- The difference between point and nonpoint source pollutants
    - Pollution can come any number sources
    - A point source is any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack
    - Non-point source is any pollution that does not come from a single source; it is often the result of run off
- Sources of air pollution
    - Cars, factories
- Sources of water pollution
    - Runoff, industrial, pesticides, city

Alternative conceptions/Conceptual challenges:

- Although human activities do have a significant impact, some air pollution is caused by the environment
    - Dust, volcanoes, smoke from wildfires…
- Not all pollutants can be filtered out by student filters
- Dirt, sand, and other natural resources can be used to clean water.

<u>(B) Investigate the types of air, soil, and water pollution such as chlorofluorocarbons, carbon dioxide, pH, pesticide runoff, thermal variations, metallic ions, heavy metals, and nuclear waste;</u>

Student's prior knowledge needed:

- Students can use their knowledge of pollutants to help them investigate further the effects and different types of pollutants specific to air, soil and water. As mentioned in 9(A).
- Students should be able to understand how ecosystems work and to be able to predict how certain disturbances (pollution) to the environment will affect it.
- A basic understanding of chemical structures and interactions between acids and bases
    - Specifically: how acidic or basic solutions are formed, in the context of pollutants, and how this affects pH of the solution
- Knowing the difference between point and nonpoint sources

Teacher's Background:

- Understand the effects of various types of water pollution.
- Know which is important to the three selected water sources
- Understand which type of filters will
- Understanding the concentrations of the pollutants and the effects based on those concentrations

What students need to understand?

- Metals and solvents from industrial work can pollute rivers and lakes. These are poisonous to many forms of aquatic life and may slow their development (interfere with cellular division), make them infertile or can result in death. Metals include mercury, iron, magnesium, lead. All can be very toxic to aquatic life.
- Pesticides, fertilizers or herbicides are used in farming and can cause detrimental effects to the aquatic environment. Run-offs (caused by heavy rain) of these pesticides can cause water pollution and poison aquatic life. Subsequently, birds, humans and other animals may be poisoned if they eat infected fish.
- pH of the water can be affected by any of the above sources or even from acid rain.
- High temperatures from power plants can cause pollution known as thermal pollution. A result of high temperatures can be that algae may grow very rapidly, taking most of the oxygen sources in the water and causing unusable (consumable drinking water).

Alternative conceptions/Conceptual challenges:

- Understanding which types of pollutants are normally associated with particular sources of water (lakes, rivers, man-made lakes, oceans).
- Student may think that using dirt and sand (which are typically thought of as dirty materials) might make the water dirtier rather than cleaner
    - Or using earth materials (charcoal) to filter water make it different might permanently change the water

<u>(C) Examine the concentrations of air, soil, and water pollutants using appropriate units;</u>

Student's prior knowledge needed:

- Differentiate the different types of air, soil and water pollutants as specified in 9(B).
- Distinguish concentration measurements (molarity, molality, etc.) by definition and by units
- Compute concentration (molarity) of solutions in moles per liter
    - This also requires students defining what moles are and what they are a unit for; also, computing moles
- Convert units and the units of those air, soil and water pollutants
    - converting from grams to moles, etc.; also, converting from mol/kg to mol/L, etc.
- Explain how/why certain concentration measurements are best used depending on the state of matter (solid, liquid or gas)
    - This requires a thorough knowledge of how states of matter differ [intuition?]

Teacher Background: Teacher should be able to...

- Fully understand which concentration to use and when it is most appropriate
- Interconvert units, particularly concentration units (molality to molarity, etc.)
- Explain why and how specific concentration types are used when calculating pH, alkalinity, etc.
- Explain why different states of matter use different concentration measurements/units
- Parts per billion/million

What students need to understand?

- Students should be able to understand the importance of certain concentrations of pollutants and how they affect the environment.
- Students should be able to calculate/test for these concentrations or other measurements (such as pH), and know what they mean in the context of the project

Alternative conceptions/Conceptual challenges:

- In evaluating concentrations of various compounds in water/air/soil, confusion exists over the various units in use.
    - Confusion in temperature units
        - how to convert from C of F to K
        - when and why K is used in calculations
        - direct relation of K to C but not to F

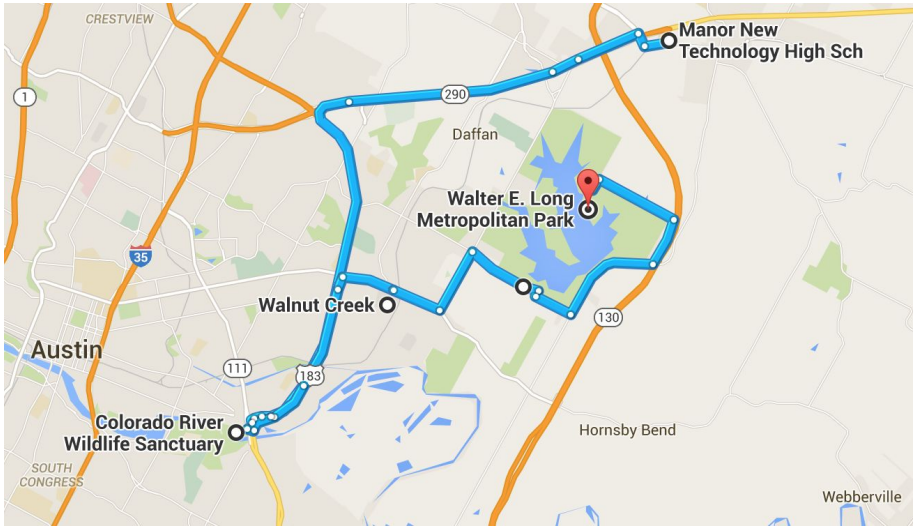
    - parts-per-billion (or million)-volume used in gas measurements is based on volume-to-volume ratio and is not the same as part-per-billion (or million) used in aqueous measurements that is based on a mass-per-mass ratio
        - possible confusion if using calorimeter

Overview of Lesson

- **Wed (10/21)**:
    - Launch idea
    - Background information on water quality/testing and filters
    - Explanation of available materials
    - Students develop initial design ideas
    - Exit ticket
        - define point and nonpoint sources
        - decide which filter they will use (now or after the field trip?)
- **Thurs (10/22)**:
    - Field trip lasting for lunch, 3rd, 4th, and club periods (11am-2pm)
    - Travel to (hopefully) three different locations
        - Students will make observations of the site
            - point and nonpoint source identification
            - sketch ecosystem
        - Test water
            - temperature
            - bacteria
        - Collect water for later testing (we are still discussing potential locations and logistics)
- **Fri (10/23)**:
    - Each group splits up based on roles
        - Designers construct water filters
        - Chemists test water collected the day before (we will have spiked it)
    - Conduct preliminary tests
- **Mon (10/26)**:
    - Students use their constructed filters to test water
    - Redesign small aspects of water filters
    - Submit data
    - Make any preparations necessary for Tuesday presentation
- **Tue (10/27)**:
    - Gallery walk:
        - Students analyze and compare their own filters to other groups
    - Analysis of overall class data
    - Students present their own filter

- Describe its strengths/weakness
- Suggest possible improvements/next steps

Proposed Field Trip Route



Day 1: Launch Video, Background Information, Start Design Process

Estimated Time	Segment Title and Description	What teacher is doing <u>step by step</u> (*Include specific questions that the teacher will ask as well as sample problems*)	What students are doing (*consider transitions to the next segment and grouping*)
		Safety: Do the following <u>each day</u> before getting started on that day's activities. Be sure to write and explain the agenda for the day so that the students will always have that to refer to. This is not only practice in this classroom normally, but it is also a way to relieve any anxiety the students may have about what is expected of them each day. Also, write the number of students in the room on the board. During the field portion of the lesson we will take precautions into ensuring the safety of students. Five or more adults will be present at all times. Adults will be helping students collect the water samples and data they need from the sites.	

		During the lab portion of the lesson, students will be required to wear goggles and gloves when performing the water quality tests. Accommodations Students working in groups can relieve some pressure of answering questions alone. The students will have group contracts to help avoid conflict. We will be emphasizing group work throughout each activity. The instructions for the activity will be given in a written form, oral form and presented on an overhead. This will help to accommodate all students.	
15min	Anchor Video and Introductions	Teacher will introduce herself/himself and establish a method of getting students attention the rest of the class: “Raise your hand when you can hear my voice” The teacher will present the anchor video as an introduction to the lesson. *“So before we discuss what we will be doing today, I wanted to present a video that will help us get thinking about an important topic. While watching the video, some questions will be asked, and I really want you all to think about what these questions mean to you.”* *“I'll give you 2 minutes after the video to talk with your table about anything you notice or anything you have questions about.* After the video: Teacher uses name sticks, or tables to call upon. *“What did the questions presented in the video mean to you?” “How do you think we can improve water, and help provide clean drinking water?”* *“Driving Question: How can I make water safe to drink?* *“Your project… is that you will all be working in a group to design a water filter.”*	Students watch the anchor video, and think about the ideas presented. Students talk with table and answer questions.
10 min	Project Background	*“Before beginning our project we are going to break into groups.*” Teacher writes the groups on the board.	Students will fill out contract and choose roles.

		"*I will be passing out a packet with the information for the project we will be starting today." But before we do so, we will be handing you group contracts...* *"Take a minute with your group to assign the roles that are seen on the group contract. This can be based on what you have interest in. A description of the roles is on the contract. Please read them over and understand what you are responsible for. If you fall short on your duties your whole team and project can suffer, keep this in mind*." *"Page 1 gives a description of the project and the objects/learning goals that you will be addressing."* ● *What pollutants are found in water sources near and surrounding Austin? What are the causes or sources of these pollutants?* ● *What types of water filters are best for filtration of the pollutants found in the water sources near and surrounding Austin?* ● *What are the effects of these pollutants on the environment?* *"These questions are going to be answered by you, through your testing of different sources of water near by….meaning that we will be taking a field trip tomorrow, to different sites to test and collect water samples."* *"Looking at page 4, you will see a list about the different water pollutions, their sources, and other pertinent information."* *"These are the pollutants that your group will be able to test. Out of the list provided your group must narrow it down to three specific pollutants you want to test for."* *On page 5 a list of materials and a few explanations of water filters are listed."*	2 Chemist:(work together on the following tasks) ● The chemists will be in charge of researching and understanding the pollutants that can be tested. ● The chemists will work together to decided which 3 pollutants to test ● The chemists are also responsible for making sure that the Engineers understand the pollutants and their effects on the environment and how to test them. ● During the field day the chemists must make sure all the equipment they are using is calibrated before use. ● During the field day the chemist also need to make sure they have the correct units for the data they collect. 2 Designers: ● The designers will be in charge of designing a water filter based on the materials that will be provided. ● The designers must consult with the chemist on the pollutants they will be testing and design their filters based on this. ● The designers must inform the chemists why their design of the water filter is a certain way. ● On day one the designers should have a finished sketch and explanation of their water filter. ● Designers must record the amount filtering agents used and an explanation on why those filtering agents were chosen. List of pollutants for students to test: Turbidity pH Carbon Dioxide (dissolved) Oxygen (dissolved) Iron Bacteria Nitrate Nitrite Ammonia
8 min	Need to Know/Know	*"Before we jump into the project, I want to address what we already know about water filtration and pollutants and what we are going to have*	

		to learn through the project" Teacher puts two big sticky notes on the board, one for Need to Know and one for what students already Know. "Okay talk with your table for 4 minutes and **as a group** come up with 2 things you know about water filtration, pollution and maybe how these affect the environment. Then come up with 2 things, **as a group**, that you don't know that you think is important when learning how to test water for pollutants and how to filter those pollutants. When you are done, one member from your group needs to come up and write what you came up with for things you know and things you do not know but are important!" Once students have written their responses on the sticky notes, the teacher will go over them as a class. *possible things students know: how pollution can affect an ecosystem, some common types of pollution, water filters involve a carbon source, some water filters contain some type of mesh. Common filters: coffee filters, store sold water filters etc.* *possible things students do not know: The way that different filtering agents should be layered to get the best filtration, which filtering agents work the best on what types of pollutants, pollutant types in water that are common, what the pollutants exactly do to the environment, how are these pollutants measured, what is the difference between point and nonpoint sources.*	Students will work with their tables to come up with 2 things they know about water filtration and pollution. And 2 things they don't know but thing are important.
15min	Research the water sources	"*Tomorrow we will be traveling to three locations to do some tests on the water and also collect water samples to run through our water filters later next week.* *Before we can go on the field trip we need to know more about these sources of water.* *The three sources of water we will be visiting are* *Colorado River* *Walnut Creek* *Walter E Long* *With your group using your iMacs and iPads, research these three*	Students will research the three locations where they will be traveling during field trip. They will answer questions about the locations. Making observations where the water is coming from and where it is running to. Also will be looking at surrounding features to see if there are any sources for pollution. Also students will research the difference between point and nonpoint sources: (part of their exit ticket)

		sources of water, and answer the questions in your packet for each. *You want to understand the surrounding environment and where the water is coming from. What is the source of water for Walter E long Lake? Where does the Colorado River travel through?* *Are there any surrounding features that may contribute to the pollution?"* *Some suggested research sites are provided in your packet for the day: The big one, google maps, use google maps to look at where the water is coming from and flowing to. Look at what surrounds the water as well. Are there building? What are the differences between the three sources? Are they different bodies of water?* *https://tpwd.texas.gov/fishboat/fish/recreational/lakes/walter_long/* *http://www.coloradoriver.org*	Define point source and nonpoint source: **A point source** of pollution refers to a single identifiable source of air, water, thermal, noise or light pollution. **Nonpoint source:**A nonpoint source pollution can refer to water or air pollution that is caused from diffuse sources. Meaning that the pollution is from many sources rather than just one. For example in water pollution a nonpoint source affects a body of water from sources such as runoff which can come from many locations. These pollutants originally came from an original source but have been transported long-range causing the multiple pollutant sources to be undistinguishable.
5min	Decided the roles	~~*"You have 5 min to discuss the roles and decided on who wants to be an engineer and who wants to be a chemist, if you have any problems let me know"*~~	
20min	Discuss pollutants and water filters	*"Alright I'm going to give you 20min to split up between chemists and engineers. Chemist research the pollutants and engineers look at your materials for the water filter.* *I want the chemist to pick 4 pollutants to describe to your engineers and engineers to come up with 2 designs for your water filters,* *Once the chemist have picked 4 pollutants and the engineers have 2 rough designs, you will come together as a group.* *The chemist will explain the 4 pollutants to the engineers and you will decided as a group which 3 pollutants you will be testing and why.* *The engineers will explain their designs to the chemists and as a group you will all decided on one design for your water filter and write the justification why you chose this design."* *"Before leaving, your Exit ticket includes a sketch and rough idea of your water filter design, your 3 pollutants you want to test, and an explanation for the differences of a point and nonpoint source."* *Teacher: Be sure to stamp this!*	Students will designate the roles. Students will work on understanding their pollutants Students will design their water filter.

		Also, be sure to discuss appropriate wear for the field trip tomorrow. "We will be going to three different sites, and do a good amount of walking. Be sure to wear tennis shoes and other comfortable shoes that you wouldn't mind walking in or getting dirty. This will ensure that everyone is safe and does not trip or anything like that."	

Day 2: Field Trip and Water Testing

Estimated Time	Segment Title and Description	What teacher is doing step by step (*Include specific questions that the teacher will ask as well as sample problems*)	What students are doing (*consider transitions to the next segment and grouping*)
11:00am	Students from Mrs. Hart's 3rd and 4th periods will be departing from Manor New Tech.	Students must provide a rough design for their water filter by Monday during class. Students will group in Mrs. Hart's room at 10:30am. At this time the students will be checked on a list and will board the buses. Once students are on the buses roll will be check again.	
30min	Students will arrive at Walnut Creek	Before beginning the teacher will remind students of the calibration required for each of the tools used to test. Also, instruct the students to either work in their groups, or at least use the buddy system as they wander around each site. They should keep each other in check and be as safe as possible instead of going off all alone anywhere. Upon arriving on location one, students will answer questions regarding the site on their field trip handout. **Once they have taken the time to observe their surroundings and to have collected pictures of any important features students will be able to test the water source (temperature and bacteria only).** **Students will test for the temperature or bacteria** (if those were chosen pollutants) the rest of the tests will be done in class tomorrow once we have spiked the water they collect Once students have tested and recorded the data for some pollutants, they will then use the provided bottles to each collect **1 liter of water.**	Once arriving on site, the adults on the field trip will divide the site so that all student have a nearby adult for safety. Gloves and hand sanitizer will be provided for students who collect water samples.

		At each site the teacher will ask probing questions/inquiry investigation questions to students: *"What type of animals, or organisms are you seeing?"* *"How much wildlife do you see, is it a small amount or a large amount?"* *"What is the color of the water? Do you think this relates to any pollutants?* Teacher walks and observes all groups to make sure they are recording properly. *"Is the pH of the water acidic or alkaline? What do you think this means?"*	
30min	Students will arrive at Walter E. Long Lake/Park	Upon arriving on location two, students will answer questions regarding the site on their field trip handout. Once they have taken the time to observe their surroundings and to have collected pictures of any important features students will be able to test the water source Students will test for the pollutants they have chosen (again, only if they are testing temperature or bacteria) Once students have tested and recorded the data for those pollutants, they will then use the provided bottles to each collect 1 liter of water.	Once arriving on site, the adults on the field trip will divide the site so that all student have a nearby adult for safety. Gloves and hand sanitizer will be provided for students who collect water samples.
30min	Students will arrive at the Colorado River	Upon arriving on location three, students will answer questions regarding the site on their field trip handout. Once they have taken the time to observe their surroundings and to have collected pictures of any important features students will be able to test the water source. Students will test for the pollutants they have chosen (again, only if they are testing temperature or bacteria) Once students have tested and recorded the data for the following pollutants, they will then use the provided bottles to each collect 1 liter of water.	Once arriving on site, the adults on the field trip will divide the site so that all student have a nearby adult for safety. Gloves and hand sanitizer will be provided for students who collect water samples.
2:00pm	Students will arrive back at Manor New Technology High School	Students will label all of their samples and place them in designated place in Mrs. Hart's room.	

Day 3: Water Filter Build Day

Estimated Time	Segment Title and Description	What teacher is doing <u>step by step</u> (*Include specific questions that the teacher will ask as well as sample problems*)	What students are doing (*consider transitions to the next segment and grouping*)
5 Min	Welcome and Goals for the Day	Teacher welcomes students back and reminds students of the goals for the day: Students will be splitting up within their groups. Designers are building the filter they chose on Wednesday while the chemists are testing the water samples that we spiked before they arrived. Once the chemists are done testing and the designers are done building, all members of each group will join forces, help each other finish their tasks, if needed, and then use their filters and run the tests and take data again after filtering. 1. Designers: a. Build a water filter as specified in the Day 1 design i. Some modifications are okay b. Document the completed filter with information including: i. Overall dimensions of the filter ii. Labeled diagram of the filter iii. Order, composition, and dimensions of the filter layers iv. Brief explanation of the reasoning behind filter choice 2. Chemists: a. Test the collected samples of water (which the teachers will have spiked) b. Test the filter to make sure that water flows through it and to rinse it 3. Make predictions about how water quality will change after being passed through your filter 4. Begin testing water samples	Students may ask for clarifications about goals for the day
10 Min	Material Collection	*"As you all already know, each group should have 2 designers and 2 chemists. The chemists will be testing the samples collected yesterday for the pollutants that you didn't do on site (all pollutants besides temperature and bacteria have yet to be tested). If you are a designer, you will be constructing the filter today."* **For designers**: *"Alright, so now we are going to start our build. Before you can get your supplies though, you must show me your completed design report. It needs to have a rough outline of your plan. I will ask you questions about the design, so be ready!"* **For chemists**: *"You guys should know which pollutants you have yet to test for, and will be doing that. Come up to the front of the room to collect your sample for each site, and the appropriate test. The instructions are in the test kit, and we will of course be here to help. Be sure to record all results/data in an appropriate manner."*	

		"Okay, so there are materials located at the front of the room. You might want to send each group member to get a specific material. Each group gets one water bottle. Take only what you think you need. You can always come back for more if you need it." The teacher moves around the room quickly checking design sketches and that the chemists are on track to test their remaining pollutants. Teachers observe the material gathering and ensure that students are gathering appropriate amounts of materials.	
30 Min	Filter Build	*"Once you have your supplies you can start building. Make sure that you build carefully as you have a limited amount of materials. Also, don't drop your filter! Rocks and sand will fly everywhere and you will have to start over!!! I will be around to check on your progress."* Teacher circulate from group to group checking on progress. *"How are we doing over here?* *What layer are you putting down?* *Why are you including that layer?* *What about the order, do you think that matters? What difference would it make?* *What about the layer thickness? What happens if it's too thick or thin?* *How long do you think it will take water to flow through the filter?* *What are your predictions about the filtration results?"* The teacher refocuses any groups that have gotten off task and gives time reminders. As groups start to finish their filter, the teacher gives instructions for preliminary testing and the design documentation. *If you have finished building, you can run some preliminary tests and start your final documentation."*	Before testing students must get a pair of goggles and gloves. They are required to wear these at all times during the water quality testing. Safety will be discussed with the students before testing proceeds.
20 Min	Preliminary Testing and Documentation	Once the majority of groups have finished, the teacher starts allowing preliminary testing. *Once you have finished building the filter, you need to start documenting your design and you can run preliminary tests.* Teacher references the rubric for documentation. *Like it says on the rubric, your group needs to document your filter's design on the large post it note. Make sure you check the rubric for all of the information,*	

		but you must include a to scale sketch of the filter, with the different layers visible. It must also include a description of what each layer does. *For the preliminary testing, you want to make sure that water actually flows through the filter. Using DI water pour water into the filter and time how long it takes to come out. This will give you a good idea oh what to expect for the real testing of your filter.*	

Day 4: Water Filter Test Day

Estimated Time	Segment Title and Description	What teacher is doing <u>step by step</u> (***Include specific questions that the teacher will ask as well as sample problems***)	What students are doing (***consider transitions to the next segment and grouping***)
5 min	Welcome and Goals for the Day	*Welcome back! Today we are actually going to test our filters. Last week, when we went out in the field for testing, we collected a lot of samples to bring back. Today we are going to use them!* *You will conduct the same three tests that you did last week using your water filter. Since you have 3 tests at three sites, you need to do 9 tests overall throughout today.* *Each group will have about 1 liter of water from each site to test. This should give you enough water for each test.* *While your water is filtering, you can continue working on your design poster. By the end of today, you also need to represent the effectiveness of your water filter. It is up to you how you represent your data, but it should be clear and easy to understand.*	Before testing students must get a pair of goggles and gloves. They are required to wear these at all times during the water quality testing. Safety will be discussed with the students before testing proceeds.
30 min	Water Testing Period	*Alright now we can start testing. Send one member to collect one sample at a time. Start filtering because it will probably take some time. When you are ready to conduct a test, you can come get one test at a time.* Students begin their testing. It is likely that the filters will take a while, so encouraging students to begin working on their final displays is a good idea. "*How will you display your results?* *Would a table or graph be better? Go ahead and do some setup work for that.* *What features of your filter will you promote?*	

		Make sure you say why you included certain features." As students test, they may realize or identify flaws in their design. If it is a fix they can quickly implement, encourage them do so, but they should record this and put it in their final presentation. If it is a bigger fix, they should just document it for their presentations. Throughout the testing, the teacher should go to different groups to make sure they are on task. Additionally, the teacher should give time warnings.	
25 min	Poster Creation	As students finish, the teacher checks over their data and asks questions about the results. *"Are these the results that you expected?* *Why do you think the filter was more effective are removing some pollutants?* *In which environment would you filter make the most difference?"* The teacher should also remind students of the criteria in the rubric for the posters. Projecting it on the board might help students stay focused on the task.	
10 min	Presentation Practice	If time allows, students will practice their presentations for Tuesday.	

Day 5: Filter Analysis and Comparison

Estimated Time	**Segment Title and Description**	**What teacher is doing <u>step by step</u> (*Include specific questions that the teacher will ask as well as sample problems*)**	**What students are doing (*consider transitions to the next segment and grouping*)**
5 minutes	Welcome and Goals for the Day	Welcome back! Yesterday we spent the day testing the filters each group built. Today, we will be doing a gallery walk to look at other groups' filters.	
10 minutes	Gallery Walk	Based on the data you obtained yesterday, you hopefully thought about ways your filter could have been different to make for more effective filtering. Today, during the gallery walk you will get the chance look at other filter designs and their results to see how effective different filters were in comparison to yours. As you walk around, be thinking about certain features you	

		would change about your filter design, had you had more time.	
10 minutes	Class Data	The data compiled yesterday was put together in an appropriate way to present the data to the class. Students will identify and possible patterns present in the overall class data based on filter design. "*Do you notice any particular pollutants that were greatly reduced after filtering?"* *"Which groups filtered out [pollutant] best? Why do you think that it?"* Students can also use this class data to see which groups had more effective filtration against certain pollutants. *"If there was one feature you could add to your filter, what would it be and why?"* *"What feature seemed to filter [pollutant] best?"*	
40 minutes	Presentations	Students, as a group, present their own filter. They will use a visual aid (poster) to illustrate their filter model and explain/justify their features. Students will also describe their filter's strengths and weaknesses. They will end their presentation by suggesting possible improvements for their filter, incorporating ideas they learned from the gallery walk. There will be a timer for each group to remind them of the time limit. Depending on how the class flows the presentation time will probably be around 5 min.	