Water We Going to do About Stroubles Creek?

Name: _____ Date: _____

Part 1

Directions: Read the letter issued to your class by the EPA. Write a brief summary of what the problem is and what the EPA is asking you to do. When directed, get with a partner and discuss your summary and thoughts. Be prepared to share with the class.

What is the problem?	What is the EPA asking you to do about it?

Part 2

Directions: Listen to the instructions your teachers give about the probeware you will be using.

Safety goggles and gloves are required!

Set up tests for turbidity, conductivity, nitrates, and phosphates for the two samples of water. Fill in the given table to compare the two samples.

Water Quality Measure:	Sample #1	Sample #2
Turbidity (NTU)		
Conductivity (µS/cm)		
Nitrates (ppm)		
Phosphates (ppm)		

Which of the two samples has better water quality? Justify your answer with the data you collected.

_____

_____

Directions: Use the given filter to determine which slope is more effective at improving water quality. Measure the slope with a ruler. Ensure that the filter is secured in the ring stand by placing it between the clamps and tightening it to securely hold the filtration system. Ensure that there is a plastic cup placed in the holder to collect the water you filter.

Procedure for Filtering Water:

1. Measure the turbidity of the water sample and record it in the data table. Record this in the Before column for the First Filtration.
2. Pour the water sample in the filter.
3. After the water sample has been filtered, measure the turbidity of the sample and record it in the data table in the After column for the First Filtration. This will also be the turbidity recorded in the Before column of the Second Filtration.
4. Take the **filtered sample** and pour it back into the filter.
5. Repeat these steps for a total of five filtrations.

Slope = $-\frac{1}{2}$		
Turbidity (NTU)	**Before**	**After**
First Filtration		
Second Filtration		
Third Filtration		
Fourth Filtration		
Fifth Filtration		

Slope = $-\frac{3}{4}$		
Turbidity (NTU)	**Before**	**After**
First Filtration		
Second Filtration		
Third Filtration		
Fourth Filtration		
Fifth Filtration		

Part 3

Directions: We will be graphing the results from your filter at a slope of $-\frac{1}{2}$.

1. Have one group member open the Desmos graphing calculator on their computer.
2. Create a table in Desmos. (Click the "Add Item" button in the top left corner of the screen and select "table").
3. Record your table from above for a slope of $-\frac{1}{2}$. The "Before" column will be your *x*-values and the "After" column will be your y-values.

We will be using **regression equations** to estimate an accurate equation to model the data.

First, we will start with a **linear regression equation**. What do you think this type of equation will look like?

For a **linear** regression, type the following into the next line in Desmos: $y_1 \sim ax_1+b$

Write the linear regression equation from Desmos. Is this a good approximation of the data? Why or why not? What conclusions can you make about your data based on your observations?

What is the slope of the linear regression equation? How is this slope different from the slope of the filter? Are these both valid examples of using slope?

Next, we will try a **quadratic** regression equation. Type the following into the next line in Desmos: $y_1 \sim ax_1^2+bx_1+c$

Write the quadratic regression equation from Desmos. Is this a good approximation of the data? Why or why not? What conclusions can you make about your data based on your observations?

In the real world, modeling relationships with mathematical equations can be hard. While we will focus mainly on linear and quadratic relationships in our class, it is important to note that these are not the only relationships out there.

Finally, we will try an **exponential** regression equation. Type the following into the next line in Desmos: $y_1 \sim ab^{x1}$

Write the exponential regression equation from Desmos. Is this a good approximation of the data? Why or why not? What conclusions can you make about your data based on your observations?

Part 4

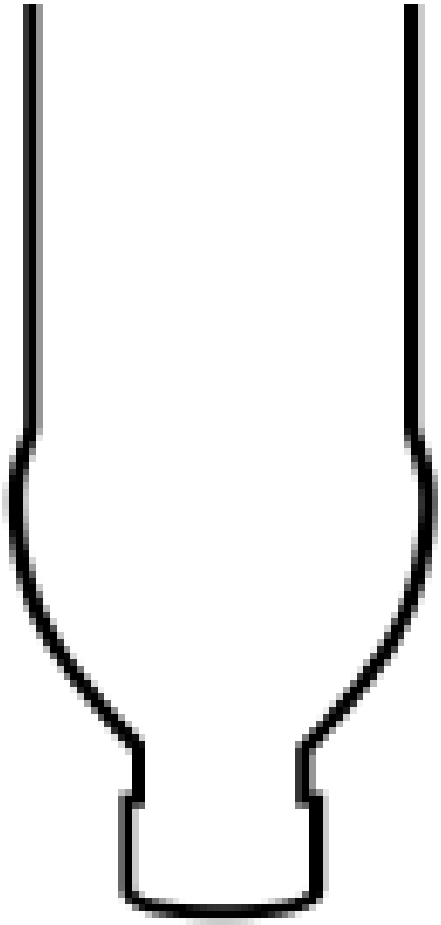
Directions: You will now design a model based on the EPA's requests and the knowledge you have surrounding water quality and slope. As a group, follow the QR codes to various sources with information about each of the materials you may use in your filter design. Write down any information that you think will inform your decisions on the filter design.

Dead Leaves		
Moss		
Sand		
Bark		
Plant Leaves		
Sediments/Rocks		
Grass		

Directions: Using the information you found about possible materials, discuss what 5 materials you should include in your filter as a group. Fill out the table below to show your reasoning.

Material	**Why did you choose this material?**
1.	
2.	
3.	
4.	
5.	

Once you have decided on 5 materials, decide what order they should be placed in the filter by referencing your research in the table above. Then create a sketch of your filter design below (remember that this filter will be layered in a plastic water bottle), and ensure that you use correct labels.



Next, you will decide on the placement of your filter on Stroubles Creek. Below you will find a map with 3 labeled sites and their corresponding slopes. Using the information you collected during Part 3 of this activity sheet, decide where the filter would be most effective as a group.

Site 1: Site 1 is the farthest from the Duck Pond. Located close to Thomas M. Murray Structures Lab, this site of the stream has a slope of $\frac{1}{4}$.

Site 2: Site 2 is farther along Stroubles Creek, located around some farmland. The slope of the stream at this location is $\frac{2}{3}$.

Site 3: Site 3 is closest to the Duck Pond. Located within Smithfield Plantation, this location on Stroubles Creek has a slope of $\frac{5}{6}$.

What site did you decide to place your filter at? Explain your reasoning.

It is now time to build a model of your filter.

Procedure for creating your model:

Safety goggles and gloves are required!

1. Obtain these items from the front of the classroom.
    a. A plastic bottle
    b. Your 5 chosen materials (only take one cup for each material)
    c. A small amount of cheesecloth to cover the opening of the bottle
    d. A rubber band
    e. A spoon
2. Place a layer of cheesecloth over the opening of the plastic bottle and secure it with a rubber band to ensure that your materials do not fall out.
3. Carefully layer your materials using a spoon or your hands.

You will now test your model.

Procedure for testing your model:

Safety goggles and gloves are required!

1. Obtain
    a. A ring stand with 2 clamps secured to it
    b. 1 empty plastic cup
    c. 1 plastic cup of sample water
    d. Ruler
    e. A conductivity probe
    f. A computer with the LoggerPro software installed
    g. A LabQuest
2. Secure your filter in the ring stand by placing the top of the bottle between the 2 clamps and tightening the bolt. Make sure it is completely secured!
3. Ensure that the filter is at the slope corresponding to which site your group chose on the map; use a ruler to measure height and length.
4. Place the empty plastic cup in the clamp containing the circular holder.
5. Plug the LabQuest into the computer and a power source.
6. Load the LoggerPro software on the computer.
7. Plug the turbidity probe into the LabQuest and ensure that it is reading (look for a reading in the lower, left hand corner of the screen).
8. Take the initial reading of the sample water and record in the data table below in the “Before” column.
9. Carefully pour your sample water through your filter, the water should flow into the cup you placed in the circular holder.
10. Once the water is done filtering, measure the turbidity and record in the “After” column; this value will be the “Before” column on the following row.

11. Complete all 5 filtrations, ensuring you record your data each time.

Slope = _____		
Turbidity (NTU)	**Before**	**After**
First Filtration		
Second Filtration		
Third Filtration		
Fourth Filtration		
Fifth Filtration		

With your group, analyze the turbidity data you collected and discuss how well your filter performed. Justify your model based on this.

Presentation Instructions:
You will be required to create a presentation describing your engineering design process, your model, the results of your tests, and a justification for the materials you chose. Create a display that will be shown at the community STEM Fair.

Make sure you take notes on other group's designs at the STEM Fair; this will be needed to write a reflection.

Reflection Instructions:
Write a one-page reflection answering the following questions:

1. Describe your engineering design process and include any challenges your group faced.
2. What would you have done differently having the knowledge that you do now?
3. Overall, how well did your filter work when compared to the other groups?
4. Taking into consideration your model and other group's models, what variations would you include in a future model?
5. Can this problem be addressed from a different angle? Address at least one other idea.

Water We Going to do About Stroubles Creek?
Presentation Rubric

Team Members:				
Criterion	**Meets Expectations** **5 Points**	**Somewhat Meets Expectations** **3 Points**	**Does Not Meet Expectations** **1 Point**	**Score**
Engineering Design Process	The team describes each of the steps of their engineering design process including any challenges they faced.	The team describes most of the steps of their engineering design process or does not include challenges that they faced.	The team does not describe the steps of their engineering design process and does not include challenges that they faced.	/5
Model	The team presents their filter model and demonstrates that the model can improve water quality by reducing turbidity. The team effectively answers questions about their model, asked by audience members.	The team presents their filter model and demonstrates that the model has potential to improve water quality by reducing turbidity. The team somewhat answers questions about their model, asked by audience members.	The team does not present their filter model or fails to demonstrate that the model can improve water quality by reducing turbidity. The team does not effectively answer questions about their model, asked by audience members.	/5
Results	The team discusses the results of their designed filter. Labeled data tables are present. The team discusses how the filter may be improved to yield better filtration results.	The team presents the results of their designed filter. The team mentions possible ways to improve filtration results but does not provide reasoning.	The team does not present the results of their designed filter. Data tables may be present but are not labeled. The team does not offer suggestions for how the water filter may be improved to yield better filtration results.	/5
Justification of Materials	The team justifies each of their 5 chosen materials using the information they discovered in their research. They effectively answer questions regarding the materials and their justifications.	The team justifies most of their materials using information they discovered in their research. They answer questions but cannot form a sound justification.	The team does not include a justification of their chosen materials. They cannot provide any answers to questions asked regarding their justification.	/5
Justification of Location (Slope)	The team justifies their chosen location on the map using information from the explore phase and how it affects the filtering of water. They demonstrate the mathematical concept of slope.	The team justifies their chosen location on the map but does not utilize information from the explore phase or demonstrate the mathematical concept of slope in relation to filtering.	The team does not include a justification for their chosen location on the map.	/5
			Total Score:	/25
Comments:				