Research Experiences for Teachers (RET) – 2015
LESSON PLAN TEMPLATE

MODULE TOPIC: Water Filtration – Why is it important? (2-3 days)

STANDARD (S) & INDICATOR (S):
NGSS: HS-ETS1-2.

- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

CCSS Mathematics:

- HSF-IF. Interpret functions that arise in applications in terms of the context.

OBJECTIVE (S): Students will be able to:

- Design and construct a device to remove substances from the water supply using the engineering design process.
- Collect analyze and organize the data collected, and represent the data graphically.

MATERIALS:
Water filtration kit (sand, gravel, etc.), coffee filters, bottles, tape, dirtied water (dirt, food coloring, grass clippings, etc.), previous research

LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)

1. Lab report template
2. Lab report rubric
3. Quality/color of water after filtration rubric
4. Laboratory instruction sheet/directions

BACKGROUND INFORMATION:

Pharmaceuticals are synthetic or natural chemicals that can be found in many types of medications, including: prescription medicines, over-the-counter therapeutic drugs and veterinary drugs. Pharmaceuticals contain active ingredients that have been designed to have specific effects on the body. There are many ways that pharmaceuticals can be introduced into water sources, which include but are not limited to sewage, wastewater from manufacturing or production facilities and agricultural runoff. Pharmaceuticals have become chemicals of concern to the public because of their potential to reach our drinking water.

There have been many advances in the sensitivity of methods for the measurement of these chemicals at very low concentrations. A number of studies have found trace concentrations of various pharmaceuticals in various water sources including wastewater, and some drinking water. These investigations suggested that pharmaceuticals are present, in trace concentrations, in many water sources receiving wastewater discharge.

The presence of specific pharmaceuticals in a water source will vary from place to place depending upon the type of pharmaceutical and the extent of discharge into the water. The occurrence and concentration of pharmaceuticals in receiving water sources, which are the primary pathway into drinking water, are dependent on dilution, natural reduction and the degree of wastewater treatment used.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:

1. Students will review the previous days lesson (medication in the water)
2. There will be a brief class discussion about water filters and the materials present. The discussion will also include topics such as what happens if we drink dirty water? Why is this a problem? Etc.
3. Students will utilize their research to design a blueprint for a water filtration device that will clean a dirtied water sample (food coloring, dirt, grass clippings, etc.).
    a. This MUST be pre-approved!!
4. Students will build their water filter according to their blueprint and filter the dirtied water.
5. Students will test their water filter
    a. Students can make changes to their design, but must get approval before they are implemented.
6. Students will write a lab report on their findings, including tables and graphs of their analyzed data.
    a. One lab report per group
    b. This will be completed as homework if not done in class

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:

-In what order should you layer the materials in order to get the most particles out?
-Why would you use some materials, but not all?
-What is in untreated/un-cleaned water?
-What happens if we drink contaminated water?
-What happens to our water on a large scale? (water treatment plants)

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:

-Lab reports (according to rubric) and data analysis

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:

-Lab report rubric (see attached)
-Quality/color of water after filtration rubric (see attached)

REFERENCES:

1. **http://wwf.panda.org/about_our_earth/teacher_resources/project_ideas/water_purification/**
2. **https://www.fishersci.com/shop/products/water-treatment-filtration/s97623**
3. **https://www.freedrinkingwater.com/water-news/remove-pharmaceuticals-from-water-not-cheap.htm**
4. **http://www.who.int/water_sanitation_health/emerging/info_sheet_pharmaceuticals/en/**

Handout: Lab Report Template

LAB REPORT

Name:

Due Date:

Partner(s):

Class Name and Period:

Title: Be creative; make sure it tells me what you did in the lab

Objective: Copy from the lab sheet!

Hypothesis: Your "if, then" statement

Research: Things about the lab, what do you know before you start? Check out the lab background for help

1.
2.
3.

Materials: What you used in the lab, be specific!

Procedure: What YOU did in the lab, step by step

Data: Charts and graphs with appropriate labels and titles

Results: Your data in paragraph form

Conclusion:

1. Was your hypothesis supported or rejected? Why?
2. How did this lab relate to current topic of study?
3. Give one example of how you will apply this information outside of school.
4. Define two vocabulary words you learned from this lab.

Handout: Lab Report Rubric

Lab Report Rubric

Element	Points Earned	Possible Points	Criteria for Points
Name, Due Date, Partners, Class Name and Period		5	- Clearly labeled on lab report
Title		2	- Clearly labeled on lab report - Creative -Explains what you did in the lab
Objective		2	- Clearly labeled on lab report -Copy of what was on lab sheet
Hypothesis		3	-Clearly labeled on lab report -"If, then" format -Testable
Research		3	-Clearly labeled on lab report -3 pieces of information that help in the understanding of the lab
Materials		5	-Clearly labeled on lab report -List of everything used in procedure
Procedure		10	-Clearly labeled on lab report -Easy to understand -List of everything done in order -As specific as possible
Data		5	-Clearly labeled on lab report -Easy to understand -Chart present -Graph present -Appropriate labels
Results		5	-Clearly labeled on lab report -Paragraph form -Explanation of table/graph
Conclusion		10	-Clearly labeled on lab report -Paragraph form -Answers 4 questions from lab sheet
Total Points:		50	
Total Percentage:		100%	

Comments:

Handout: Quality/color of water after filtration rubric

Water Filtration System Rubric				
	Excellent (25 points)	**Good (20 points)**	**Fair (15 points)**	**Poor (10 points)**
Water Clarity	**Completely clear – as drinking water might appear**	**Quarter to half of the dirt remains**	**Three-quarters to half of the dirt remains**	**Completely dirty – as the original water appeared**
Levels of Filtering	**More than 3 levels of filtering**	**3 levels of filtering**	**2 levels of filtering**	**1 level of filtering**
Blueprint	**Illustration present All levels labeled**	**Illustration present No labels**	**Illustration does not represent final project**	**No illustration present**
Total:				

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Handout: Lab instruction sheet/Directions

Name: _____Date: _____

Group Members: _____

Water Filtration – Is it important?

Background:

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The presence of specific pharmaceuticals in a water source will vary from place to place depending upon the type of pharmaceutical and the extent of discharge into the water. The occurrence and concentration of pharmaceuticals in receiving water sources, which are the primary pathway into drinking water, are dependent on dilution, natural reduction and the degree of wastewater treatment used.

There are two methods that water filters utilize to reduce contaminants. They either physically block their passage through filter media or chemically attract them to the filter media.

Due Dates:

Task 1: _____

Task 2: _____

Task 3: _____

Task 4: _____

Task 5: _____

Your Task:

7. Research your assigned medication to see how it may enter the water supply.
    a. Write a 2-3-paragraph explanation of how and why this occurs.
    b. Create a mini-poster with the information from your summary (and images) to share with your classmates.
    c. During poster presentations, you are responsible for completing the graphic organizer for other groups' research.
8. Utilize your research to design a blueprint for a water filtration device that will clean a dirtied water sample (food coloring, dirt, grass clippings, etc.).
    a. See attached rubric for guidelines
    b. This MUST be pre-approved!!
9. Build your water filter according to your blueprint and filter the dirtied water.
    a. See attached rubric for guidelines
10. Test your water filter!
    a. You can make changes to your design, but must get approval before they are implemented!
    b. See attached rubric for guidelines
11. Write a lab report on your findings, including tables and graphs of your analyzed data.
    a. See attached template and rubric
    b. One lab report per group

Helpful References:

https://www.arhp.org/publications-and-resources/contraception-journal/august-2011

http://www.poison.org/current/water%20supply.htm

http://toxics.usgs.gov

http://www.noaa.gov/features/protecting_1208/pharmaceuticals.html

http://water.epa.gov/scitech/wastetech/guide/304m/index.cfm

http://www.epa.gov/ppcp/faq.html

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