Endeavor
STEM Teaching Certificate Project

Metro Water Services Field Trip

Grade(s): 11th Grade

Lesson Duration: 1 Day for trip plus 1 Day for follow-up

Course Name(s): Interdisciplinary Science III

Description:

This field trip serves as a supporting field experience for the Water Quality unit for the junior Interdisciplinary Science III class. Students will spend the day touring 3 different water treatment plants in the Nashville Area – the Drinking Water Treatment Plant, the Wastewater Reclamation Plant, and the Biosolids Facility. Additionally, students will have the chance to meet staff from each plant to hear about "a day in the life". The rationale for selecting this location is that it supports our lessons about different types of pollutants in our waterways that fuel problems in the ocean and beyond – notable, nitrogen waste including fertilizers and human waste. This will help the students see how our city cleans their water, removes nitrates, and even helps use the waste to develop a low-nitrate organic fertilizer that can be used in place of traditional fertilizers.

Itinerary:

7:45 am – Leave John Overton High School

8:30 am – 9:30 am – Tour Drinking Water Treatment Plant (3181 Heartland Dr.)

9:30 am – 10:00 am – Travel

10:00 am – 11:00 am – Tour Wastewater Treatment Plant (1360 County Hospital Rd.)

11:00 am – 12:30 pm – Lunch at the Downtown Farmers Market

12:30 pm – 1:30 pm – Tour Biosolids Facility (1810 Cement Plant Rd.)

1:30 pm – 1:50 pm – Travel back to John Overton High School

2:00 pm - Arrive back at John Overton High School

State Education Standards Addressed:

EVSC.ESS3.13: Analyze and interpret data on the effects of land, water, and air pollution on the environment and on human health. Propose solutions for minimizing pollution from specific sources.

EVSC.ESS3.15: Evaluate current methods of waste management and reduction and design possible improvements.

Lesson Objectives:

By the end of the activity, students will be able to:

- Understand the environmental impacts of nitrate pollution, including its role in causing algal blooms and hypoxia.
- Evaluate how wastewater treatment plants and biosolids facilitates mitigate nitrate pollution and contribute to sustainable waste management
- Interpret NASA satellite data to identify patterns of nitrate pollution and algal blooms, understanding the role of technology in environmental monitoring
- Assess current waste management practices and design potential improvements to enhance their effectiveness in reducing environmental pollution.

Procedures:

Before completing this field trip, students will have been introduced to Nitrate as a pollutant through a few lessons. Initially, I will provide an interactive lecture wherein we discuss the concepts of nitrate as both a nutrient and a toxin, give an overview of the nitrogen cycle, and share NASA satellite imagery of algal blooms. Students will also have completed a jigsaw using news articles related to nitrogen pollution.

Am initial field experience will involve students using the HACH Chemical Testing kits to test nitrogen, ammonia, phosphate, dissolved oxygen, and pH levels in our watershed and data across several locations. We will also complete a Data Analysis Activity for students where they analyze trends in chlorophyll-a concentrations and nitrate levels using NASA satellite data. Lesson plans for all of these activities will be submitted as a separate assignment for this course.

During the field trip, students will be provided with handouts of the worksheets on Page 3-7 of this Lesson Plan. They will be given a pencil and clipboard for writing on during their visit. They will be asked to complete the worksheets during the trip and to return it to me when we return to John Overton High School.

Proof of Visit:

See pages 8-9 for photos from our recent visit earlier this month! Students reported enjoying the worksheets, which made it more interesting and interactive than in past years.

Drinking Water Treatment Plant Worksheet

Name: _____ **Date:** _____

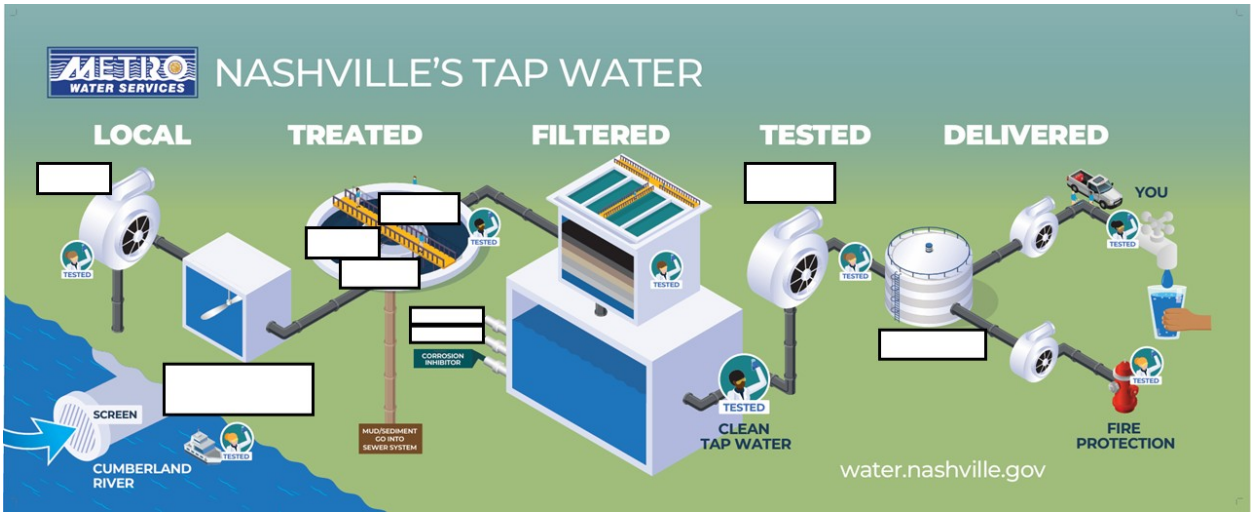
Instructions: Match the following words to their definitions:

Vocabulary Term	Definition
1. Backwashing	A. A settling tank in which mud settles to the bottom.
2. Clarifier	B. Particles of mud get heavy and fall to the bottom of the tank.
3. Coagulation	C. When the filter is getting full of particles and the water is not able to easily flow through the filter.
4. Disinfection	D. The destruction of disease-causing organisms.
5. Filtration	E. River water before any chemicals have been added.
6. Flocculation	F. Small pieces of mud stick together to make a larger, heavier piece of mud that will settle to the bottom.
7. Loss of head	G. Filters are cleaned by spraying water through the filter from the underside of the filter.
8. Raw Water	H. How clear the water is.
9. Sedimentation	I. The removal of small particles in the water by passing the water through material that catches and holds the particles
10. Turbidity	J. The slow mixing of water to cause the particles of mud to stick together.

Diagram: Drinking Water Treatment Process

Below is a simplified diagram of the drinking water treatment plant. Label the following parts of the process:

- Pumping Stations
- Fluoride
- Reservoirs
- Flocculation
- Sedimentation
- Intake
- Pre-treatment
- Coagulation
- Disinfectant



Comprehension Questions:

1. What is the primary source of the water treated at this plant?

2. How does coagulation help in the water treatment process?

3. What method is used to disinfect the water, and how does Nashville differ from other plants using this disinfectant?

4. What was the most fascinating part of the drinking water treatment process that you observed during the visit?

Wastewater Reclamation Plant Worksheet

Name: _____ **Date:** _____

Instructions: Match the following words to their definitions:

Vocabulary Term

1. Aeration
2. Aerobic microorganisms
3. Biological treatment
4. Microorganisms-to-food ratio
5. Pathogens
6. Return of microorganisms
7. Ultra violet light disinfection
8. Wasting of microorganisms
9. Wastewater
10. Wastewater microorganisms
11. Water reclamation

Definition

A. When microorganisms are piped out of the plant to keep the microorganism-to-food ratio balanced
B. An alternative to chemical treatment of water
C. Saving water that the community used by cleaning it and returning it to the river
D. Harmful organisms that can make people and animals sick
E. Used instead of chemicals to disable microorganisms so they cannot cause harm
F. Returning microorganisms to the aeration tanks to continue cleaning the water and keep the ratio balanced
G. Aka sewage – dirty water from homes and businessed
H. Found in soil and our own stomach; these naturally-occurring organisms are used to clean wastewater
I. For wastewater treatment to work properly, there has to be a balance

between the amount of microorganisms and the amount of incoming food (wastewater).

J. Microorganisms that need oxygen to survive
K. Adding air for the microorganisms to survive

Stages of Wastewater Treatment

Briefly describe the primary, secondary, and tertiary treatment stages observed during the visit:

- **Primary Treatment:**

- **Secondary Treatment:**

- **Tertiary Treatment:**

Challenges:

1. What challenges were mentioned by staff regarding wastewater management?

2. Before the creation of the Biosolids plant, what did Nashville do with the waste that was produced from the Water Treatment Plant?

3. Note one new insight you gained from the visit:

Biosolids Plant Worksheet

Name: _____ Date: _____

Answer the following questions using complete sentences:

1. What is the purpose of the Biosolids Facility? Write down why this facility exists and what it does.

2. How does the facility reclaim water and solids? Explain what happens to the water and the solids during the treatment process.

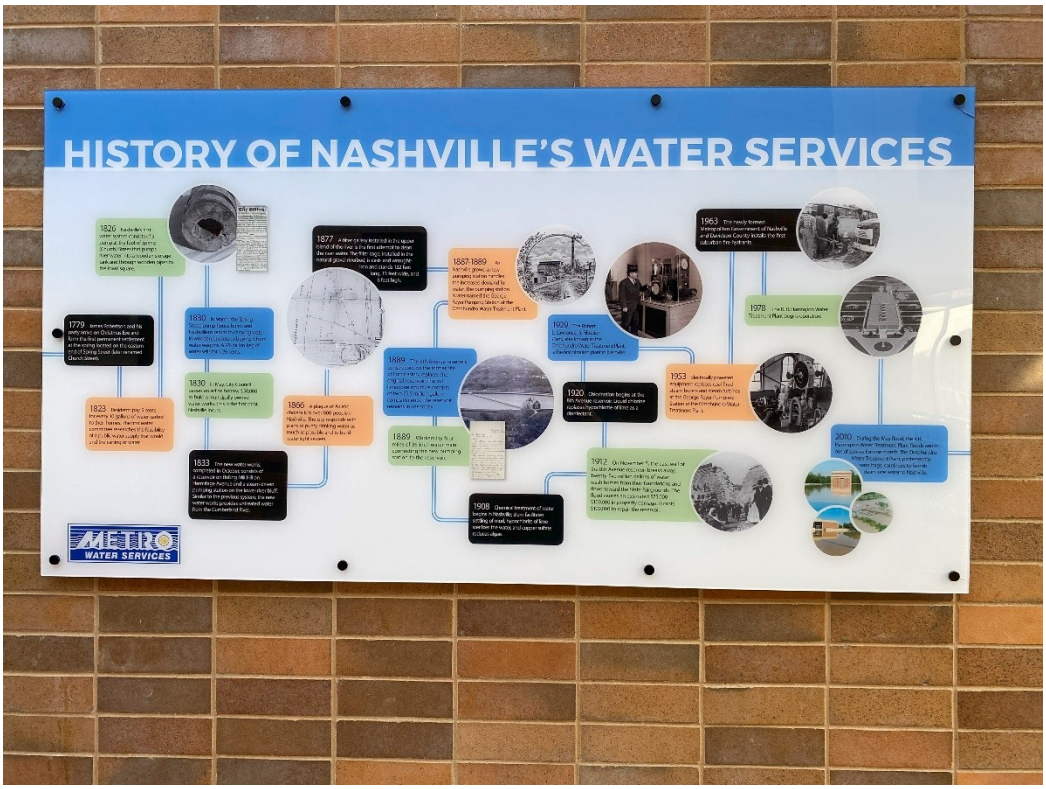
3. What are “Class A Exceptional Quality Biosolids”, and how are they used?

4. How are biosolids made at this plant? Write down the two steps of the process and describe how they work:

   1)

   2)

5. List two ways the facility saves Nashville money and helps the environment.


HISTORY OF NASHVILLE'S WATER SERVICES
METRO
WATER SERVICES