

Inquiry Project Design Plan

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| Teacher/Designer Names: Maura Casey, Kristen Presto, Lisa Seale | |
| Name of Project: Water Filter Design | Grade Level: 9-12 |
| Est Launch Date: November 2023 | Est Duration (in weeks): 5 Weeks |
| Disciplines Involved: Biology, Chemistry, Earth Science, Technology, Engineering | |
| Problem Statement: Fresh water is essential for all living organisms. When fresh water is not available, organisms cannot maintain homeostasis, and therefore, die. It is imperative for the survival of all organisms to obtain fresh water. | |

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| STAGE 1: DESIRED RESULTS | |
| Big Idea: Survival | |
| Enduring Understandings: <ul style="list-style-type: none">All organisms interact with abiotic and biotic factors to maintain homeostasisAll organisms require water for survival | Essential Question(s): <ul style="list-style-type: none">How can we design a water filter to create drinkable water from a nearby source? |
| Established Goals (Standards, Performance Indicators, Learning Goals): *choose relevant standards to unit/project plan timing and learning goals; do not need to use all disciplines below. ** unpack into SWK and SWBAT under identified standards as this will lead to aligned assessment design | |
| Science Standards: HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity Science and Engineering Practices: Constructing Explanations and Designing Solutions | |
| Technology Standards: <ul style="list-style-type: none">NYS Computer Science and Digital Fluency: Digital Literacy: 9-12.DL.4 Independently select advanced digital tools and resources to create, revise, and publish complex digital artifacts or collection of artifacts.ISTE: 1.4 Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. 1.4a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. 1.4c Students develop, test and refine prototypes as part of a cyclical design process. | |
| Social Justice Standards: Diversity 6: DI.9-12.7 I interact comfortably and respectfully with all people, whether they are similar to or different from me | |

Inquiry Project Design Plan

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| Links to Standards/Reference Frameworks: NGSS , NGSS by DCI Nat'l C3 SS Framework , NYS K-8 SS Standards , Common Core , ISTE , Learning for Justice Social Justice Standards , CASEL SEL Framework , NYS CS and Digital Fluency | |
| Students will know (SWK): | Students will be able to do (SWBAT): |
| <ul style="list-style-type: none">Organisms require fresh water in order to maintain homeostasisPolluted and/or salt water sources are not consumable | <ul style="list-style-type: none">Design a water filter from different materials to create drinkable waterMeasure the effectiveness of their water filter by using probes to collect data on pH, alkalinity, turbidity, dissolved oxygen, nitrates, salinity , and phosphates |

STAGE 2: EVIDENCE & ASSESSMENTS:

Performance Task Narrative:

Goal: You must design a water filter, using the Life Filter as a model, to create drinkable water from a nearby water source (Bronx River). You will have access to the following materials: rocks, pebbles, sand, activated carbon, cotton balls, water bottles, scissors, paper towels, rubber bands.

Role: Students will play the role of engineers, designing what they think will be the most successful water filter for removing particulate matter from water from the Bronx River

Audience: The target audience for this project is other engineers (fellow classmates), as well as the community, City of Yonkers Waterworks?

Situation: You are in a plane crash and find yourself and your fellow passengers stranded on an island, with no access to fresh drinking water. You do, however, have whatever materials exist on the island, as well as the baggage from the plane (rocks, pebbles, sand, activated carbon, cotton balls, water bottles, scissors, paper towels, rubber bands, etc.) Knowing that the

Inquiry Project Design Plan

salt concentration in the ocean water is hypertonic relative to your cells and would actually disrupt homeostasis quicker than drinking no water at all, you understand the importance of finding a source of fresh water. When you quickly realize that no such source exists on the island, you realize you must use your knowledge of biology and chemistry to create one!

Product(s):

- Students will create a water filtration system designed to make drinkable fresh water from water from the Bronx River
- Incorporate findings from habitat research into research journal
- Canva presentation

Standards (criteria for success): *Provide students with a clear picture of success. Identify specific standards for success.*

- Water filter must produce water in an acceptable range for the following values:
 - turbidity
 - salinity
 - pH
 - Dissolved oxygen
 - Carbon dioxide
 - Microorganisms
 - Phosphates
 - Nitrates

Other Evidence/Assessments:

Students will present their completed filter through the use of a Canva presentation

STAGE 3: THE LEARNING PLAN:

Inquiry Project Design Plan

| Learning Activities |
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| (potential layout below. Can be daily, divided by periods, or even using the Engineering Design Process to divide into stages such as Ask, Imagine, Plan, Create, Improve) |
| Week 1 |
| Learning Goals: <ul style="list-style-type: none">Day 1: Students will learn to describe organisms’ interactions with the biotic and abiotic factors in their environmentDay 2: Students will understand how organisms require water to maintain homeostasis within their cellsDay 3: Students will understand the factors that affect the rate of diffusion/osmosisDay 4/5: Students will perform a lab activity to observe how different salinity concentrations affect the rate of diffusion (isotonic, hypotonic, hypertonic) |
| Learning Events: <ul style="list-style-type: none">Mini lessons each day covering the following concepts:<ul style="list-style-type: none">Abiotic/biotic factorsHomeostasisDiffusion/osmosis<ul style="list-style-type: none">HypotonicIsotonicHypertonicLab activity observing the diffusion of water across the cell membrane |
| Formative Assessments: <ul style="list-style-type: none">Students will complete daily Do Nows and exit tickets assessing their understanding of each day’s objective.They will also be required to submit the lab with a full lab report containing the prediction, description of the investigation, identification of the data, details of the experimental conditions, materials and methods, data tables, and conclusions drawn from research |
| Notes/Resources: <ul style="list-style-type: none">Daily Do Nows/exit ticketsLab activity (lab materials)ProbesWater samples |
| Week 2 |
| Learning Goals: <ul style="list-style-type: none">Day 1: students will be introduced to the project requirements to design a water filter to create clean drinking water from a nearby water source (EDP step: ask)Day 2-4: students will use an investigation template and checklist to gather data to be used as evidence to identify the following values for the untreated water sample:<ul style="list-style-type: none">TurbiditySalinitypHDissolved oxygenCarbon dioxideMicroorganisms |

Inquiry Project Design Plan

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| <ul style="list-style-type: none"><ul style="list-style-type: none">○ Phosphates○ Nitrates• Day 5: students will brainstorm in groups on their plan to engineer a water filter to create clean drinking water from the Bronx River sample (EDP step: imagine/plan) |
| Learning Events: <ul style="list-style-type: none">• Students will work collaboratively to analyze water samples and interpret their data from the untreated water, to later be compared to the water treated with their filter design• Students will begin their design plan to construct their prototype of their water filter |
| Formative Assessments: <ul style="list-style-type: none">• Investigation template• Investigation checklist• Prototype submission |
| Notes/Resources: <ul style="list-style-type: none">• Lab equipment• Probes |
| Week 3/4 |
| Learning Goals: Week 3 <ul style="list-style-type: none">• Day 1-2: Students will design and construct their water filter using the available materials and their prototype from week 2• Day 3-4: Students will collect and analyze data on their treated water• Day 5: Students will create a Canva presentation to share their results with the class the following week Week 4: <ul style="list-style-type: none">• Day 1: Students will hear from a guest speaker from the Yonkers Department of Public Works on the process of water treatment• Day 2-5: Students will present their filter and Canva presentation to their fellow engineers (peers) |
| Learning Events: <ul style="list-style-type: none">• Building water filter• Collecting data on treated water• Creating Canva presentation• Guest Speaker• Students presentations |
| Formative Assessments: <ul style="list-style-type: none">• Students will be graded based on their investigation checklist, investigation template, and Canva presentation• Students will also submit a reflection based on their experience |
| Notes/Resources: <ul style="list-style-type: none">• Canva• Guest Speaker |

Inquiry Project Design Plan

- Filter materials