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| Title | An Investigative Study On The Types Of Chemicals And Their Concentration Levels That Have Negative Impacts On The Chesapeake Bay Water Quality |
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| School, District | Baltimore Polytechnic Institute, Baltimore City Public Schools |
| Audience (grade, course) | 10th-12th Grade Levels, Chemistry 1 |

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| Curriculum Anchor |
| Learning Objectives and Curriculum ConnectionCurriculum indicators, performance expectations, and/or learning objectives. |

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| \*Curriculum Alignment: NGSS* HS-PS1-5.
* Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.[Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

\*Common Core State Standards Connections:

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| * ELA/Literacy -
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| [**RST.11-12.1**](http://www.corestandards.org/ELA-Literacy/RH/11-12) | [Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.](http://www.corestandards.org/ELA-Literacy/RH/11-12) (HS-PS1-5) |
| [**WHST.9-12.2**](http://www.corestandards.org/ELA-Literacy/WHST/11-12) | [Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.](http://www.corestandards.org/ELA-Literacy/WHST/11-12) *(HS-PS1-5)* |
| * Mathematics -
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| [**MP.2**](http://www.corestandards.org/Math/Practice/MP2) | [Reason abstractly and quantitatively.](http://www.corestandards.org/Math/Practice/MP2) (HS-PS1-5) |
| [**HSN-Q.A.1**](http://www.corestandards.org/Math/Content/HSN/Q) | [Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.](http://www.corestandards.org/Math/Content/HSN/Q) *(HS-PS1-5)* |
| [**HSN-Q.A.3**](http://www.corestandards.org/Math/Content/HSN/Q) | [Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.](http://www.corestandards.org/Math/Content/HSN/Q) *(HS-PS1-5)* |

\*Learning Objectives: At the end of the research investigation, students should be able to:* Devise a method of identifying harmful chemicals in the Chesapeake Bay.
* Identify the chemicals and/or their sources that have negatively impacted the water quality of the Chesapeake Bay.
* Measure the concentration levels of the chemicals known to harm the bay.
* Create a poster board highlighting the results of their investigative study.
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| Driving QuestionA broad, open-ended, life-relevant question that is based on the standards/learning objectives. Guides inquiry for the investigation(s), prompts the development of actionable claims. |

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| What types of chemicals and their concentration levels are harmful to the Chesapeake Bay? |

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| ContextEstablishes local connections and life-relevancy of the core ideas in the learning objective and driving question. |

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| * Students will be presented with information about the Chesapeake Bay, its past, present, and future state through articles, web searches, videos, a talk from an expert, and possibly field trips. These activities will open their minds to what truly are the issues of the bay and will hopefully give them the motivation and dedication to investigate one issue that is adversely impacting the water quality of the bay and that is the increasing amounts of toxic chemicals.
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| Issues Investigation |
| Asking Questions, Defining Issues and ProblemsStudents define the issue, problem, or phenomenon to be investigated and develop questions that are relevant for investigation. |

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| * The investigative study will be given at least ten school days to complete in spring. Students by then have learned chemical equations and how to quantify chemical reactions. This investigation will be very fitting in connecting their learning to the outside world, the world that they live in. Students will brainstorm ideas and create their own leading questions to answer the driving question. Some examples for leading questions will be as follows:
	1. What are the harmful chemicals present in the bay?
	2. At what level of concentration are they harmful?
	3. How do we test these chemicals?
	4. What method is best in identifying toxic chemicals in the bay?
	5. What instruments and equipment are needed to measure the concentration levels of the hazardous chemicals?
	6. What are the agencies we can consult with to confirm our results?
	7. What are some main sources of the toxic chemicals in the bay?
	8. How do these chemicals get into the bay?
* Since this is an inquiry-based investigation, students are tasked to choose the appropriate resources to use such as websites, articles, interviews, videos, etc.
* Students must come up with a poster board summarizing their findings and must be available to answer questions about their results if necessary. Their poster board should detail the methodology they employed and the instrumentation they utilized to quantify their investigation. There will be a rubric for grading their poster board which will be given prior to the start of the project.
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| Planning & Conducting InvestigationsStudents develop plans for collecting, analyzing, and communicating information and/or data to help them answer their questions and understand the problem. Students identify and justify appropriate sources of information and/or data, and determine methodologies for the collection of information and/or data.  |

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| * As stated above, an inquiry-based investigation allows students to carry out the task with less teacher intervention and guidance. In this light, students must achieve their research study independently from the teacher but collaboratively with their group mates. Each group will comprise of 3-4 students picked by the students themselves. This project is not compulsory as this is treated as an extra credit opportunity, but all students are encouraged to participate.
* When the third quarter ends, students should have acquired lab skills and concepts from doing chemistry labs needed for this special endeavor. They should have already known the use/purpose of basic lab equipment, as well as what tools to use for what purpose. They should also have acquired measuring and identifying skills such grouping, organizing, sorting, filtering, distilling, weighing, and even calculating for the molar masses.
* Students can always seek guidance and assistance from the teachers, adult staff, school administration, experts, agencies, and even visit sites to conduct their investigation. Parent involvement is also highly appreciated.
* As mentioned above, students need to post their data creatively and informatively in a poster board. A rubric will be developed for each criterion such as methodologies, abstract, materials, data collection and analysis, conclusion, and even recommendations.
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| Analyzing and Interpreting Data Students represent and share information and/or data to reveal patterns that indicate relationships. Students apply disciplinary concepts as they analyze and interpret information and/or data to make sense of the issue or phenomenon. |

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| * Students will need to explain individually or as a group how they came up with their results or data, what they had to do to achieve the assignment, and what challenges they had to hurdle to become successful.
* Each group is required to present a narrative description of what they learned from their investigation and how they applied the knowledge and skills in real life situations. They can also include in the presentation their first-hand experience on what worked and what did not.
* Analyzing and interpreting data is part of the criteria for grading students. A rubric will be prepared for this criterion. Important stress is given to how students analyze their data both qualitatively and quantitatively.
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| Constructing, Communicating, & Refining ExplanationsStudents identify and apply evidence from their investigations (for example, measurements, observations, and patterns) to construct, communicate, and refine explanations about the driving question. |

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| * In their poster board, students will be handed out a copy of the criteria and rubrics so they know right away what is expected of them. In their conclusion, students must be clear, concise, and explicit of their findings and explanation of their results based on their data and observations. They must include a quantitative evidence gathered using appropriate methods and instrumentation. Photos and other graphics are encouraged in their presentation.
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| Civic Engagement |
| Develop a Claim Students develop and present a claim (a belief or opinion grounded in factual knowledge that is based on evidence from the analysis of data and constructed explanations from the issues investigation).  |

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| * Students will first group themselves and brainstorm on what chemicals are present in the bay in toxic quantities. They will each make a list of these harmful chemicals based on information gathered through interviews, videos, articles, and websites. Then they will decide how to carry out their investigation such as what method, tools, equipment, and materials to use, which location to go, and even what transportation is available if they decide to do an on-site investigation. They can collect water samples from different locations to take back to school where they can further do testing. We have water sampling kits available at school that students can use, but they are allowed to use other equipment if they choose to do so.
* Students must record all procedure, observations, results/findings, calculations, and number of trials in an organized manner such as graphs, pictures, and other graphics and present a summarized version of each step on their poster board.
* A rubric is available for each criterion. All this is already mentioned above.
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| Design a Solution and Implement Action Students assess their individual and collective capacities to take action to address the problem or issue of their claim. Students develop a plan to apply a range of deliberative procedures to take action in their classrooms, schools, and/or in out-of-school civic contexts. Student’s Civic Engagement plans should define the criteria for success of the action as a solution to the problem or issue.  |

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| * Through their poster board presentation, each group of students will have the power to inform everybody in the school, and even outside the school, about the toxic chemicals that are finding their way into the Chesapeake Bay. Loaded with evidence and know-how, students are more confident to talk about the issue and even share with other people what their investigation is all about.
* They can also give talks about their experiences while conducting their investigative study. They can further educate other people by informing everybody about the sources of the toxic chemicals so everybody can avoid or lessen the use of them. They can recommend effective ways on addressing the issue at hand based on their interviews with experts or from their own research. Students must clearly see that the significance of their project is to inform, educate, and empower the community to take action to help the Chesapeake Bay.
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| Evaluate Action Students analyze the effectiveness of the action as a solution to the problem or issue based on determined criteria. |

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| * After the project, one day of the class period will be allotted to evaluating the effectiveness of the project. It will be done in the class so even those who did not participate can get involved. During this part of the project, each group will have the time to discuss and share what they think is the overall outcome of the study. They will answer questions about the activity such as: (1) Do you think the project was successful in informing people about toxic chemicals in the bay? Why or why not? (2) Do you think people are now moved to take action in addressing the issue you presented after your presentation? Why or why not? (3) What is the next step to do?
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