**The Mercury Project UbD Planning**

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| **Title: The Mercury Project** | **Subject/Course: IES (WUHS), Advanced Laboratory Biology (SHS)** |

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| **Topic: Hg Toxicity in the Environment and the Scientific Method** | **Grades: 9-10** | **Designers: Stainton, Cross, Ferland, Scott** |

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| **Stage 1- Desired Results** |
| **Established Goal:**To have students become stewards of the land by conducting empirical research related to toxins in their local environment. |
| **Understandings:****Students will understand…*** National Parks were developed by citizens and require citizens to act as stewards of the land.
* The importance of civic engagement.
* Hypotheses are neither right nor wrong; they are either supported or not supported.
* Scientific questions can be answered by setting up an experiment, collecting data and analyzing results.
* Scientific experiments require the absence of human bias.
* Collecting and analyzing small numbers of live organisms helps scientists have a better understanding of how mercury bioaccumulates.
* The scientific process requires new findings to go through a process of communication and peer review for verification.
* The Earth’s system operates with interconnected cycles – some of which are cycles of toxins.
 | **Essential Questions:**Why is it important for us to protect, appreciate, and be engaged with our national parks?What types of questions and hypotheses can be answered by science?What elements of design are critical in conducting a scientific investigation?How do we identify sources of error and quantify their impact on data?How do we know if a scientific conclusion is valid?What are the relationships among scientific hypotheses, theories, and laws?How are food webs affected by environmental toxins? |
| **Students will know…*** Mercury (Hg) is toxic in small quantities to many organisms and is toxic to humans as a neurotoxin.
* There are many sources and hazards associated with mercury
* Hg occurs in 3 forms – elemental, gaseous, and as the compound methylmercury
* Methylmercury is a byproduct of metabolism by anaerobic bacteria, typically living in an acidic environment where they have access to carbon and sulfur
* The definition and difference between bioaccumulation and biomagnification
* In NE most of the mercury that gets into the food web comes from the air as a byproduct of the generation of electricity by coal burning plants
* The mercury cycle has parts
* Some locations are hotspots for mercury
* Dragonfly nymphs are a key part of the aquatic food web and they are exposed to mercury as they feed
* Mercury can be found in a lot of components of a study site: soil, water, organisms, plants, etc…

**Ecology*** An ecosystem is made up of abiotic and biotic factors
* Many organisms have symbiotic relationships in an ecosystem
* There are dominant wind/weather patterns across the US
* The biosphere has levels of organization within it (from atoms to the biosphere)
* There are nutrient and energy cycles in a food web that include macroinvertebrates
* Dragonflies have a distinct life cycle
* How concentration is measured and calculated
* The characteristics of a watershed
* What stewardship, service learning, volunteering, and being a citizen scientist mean
* What energy pyramids are and how energy is transferred between trophic levels.

**Scientific Method*** The parts of a properly written hypothesis, and that a hypothesis can grow out of some type of model
* The steps taken for analysis of the samples at the Dartmouth Trace Element Analysis Laboratory
* What makes a question testable
* The parts of a RERUN conclusion
* The meaning of variability and standard deviation in data
* The parts of a graph and data table (proper labeling)
* The different types of graphs and when each type is appropriate
* How to define, differentiate, and utilize the terms quantitative and qualitative
 | **Students will be able to …*** Develop a testable problem question.
* Develop a hypothesis in the “if… then… because” style.
* Collect field data using “clean hands/dirty hands” technique.
* Properly identify and label samples from the field.
* Prepare materials for use in the field.
* Conduct background research to further understand their problem question.
* Develop methodologies for finding an answer to a question.
* Use Excel or another software/online program for creating graphs and data analysis.
* Utilize the RERUN method for conclusion writing.
* Create a final poster for presentation using PowerPoint that has been edited for GUM (grammar, usage, and mechanics).
* Share findings of experimentation with peers and the public in a poster session.
* Actively and effectively participate in a peer review of other students’ projects.
* Analyze data for variability.
* Think critically about data.
* Operate a GPS unit and associated software.
* Access and utilize tools and materials available to them.
* Self-assess their work for the unit.
* View themselves as scientists.
* View themselves as people who can make a difference in the park, their community, and in the lives of others.
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| **Vermont Grade Level Expectations****Inquiry**9-12:1 – Scientific Questioning9-12:2 – Hypothesizing9-12:3 – Experimental Design9-12:4 – Conducting an Experiment9-12:5 – Representing Data9-12:6 – Analyzing Data9-12:7 – Explaining Data9-12:8 – Applying Results**Earth**9-12:46 – Cycles9-12:48 – Wind systems9-12:49 – Natural cycle disruptions**Life**9-12:34 – Energy Flow in an Ecosystem9-12:35 – Food Webs9-12:36 – Equilibrium9-12:37 – Recycling9-12:38 – Classification**Physical**9-12:9 – Properties of Matter9-12:10 – Properties of Matter | **New Hampshire Grade Level Expectations****Science Process Skills**S:SPS2:11:1 – Nature of ScienceS:SPS2:11:2 – Systems and EnergyS:SPS2:11:4 – Patterns of ChangeS:SPS2:11:5 – Form and FunctionS:SPS3:11:1 – Collaboration in Scientific EndeavorsS:SPS3:11:2 – Common Environmental Issues, Natural Resources Management and ConservationS:SPS3:11:3 – Science and Technology, Technological Design and ApplicationS:SPS4:12:1 – Information and Media LiteracyS:SPS4:12:2 – Communication SkillsS:SPS4:12:3 – Critical Thinking and Systems ThinkingS:SPS4:12:3 – Problem Identification, Formulation and SolutionS:SPS4:12:5 – Creativity and Intellectual CuriosityS:SPS4:12:6 – Interpersonal and Collaborative SkillsS:SPS4:12:7 – Self DirectionS:SPS4:12:8 – Accountability and AdaptabilityS:SPS4:12:9 – Social Responsibility**Life Science**S:LS1:11:2 – Living Things and OrganizationS:LS2:11:1 – EnvironmentS:LS2:11:2 – Flow of Energy and Recycling of MaterialsS:LS3:11:1 – ChangingS:LS4:11:3 – Human IdentityS:LS5:11:2.1 – ToolsS:LS5:11:3 – Social Issues Local and Global |
| **Woodstock Union High School Learning Expectations**InquirySkilled Information ProcessorCollaborative WorkerEffective Communicator | **Stevens High School Core Competencies**1 – Nature of Science2 – Field/Lab Safety3 – Characteristics of Life4 – Environmental Factors5 – Taxonomy  |
| **Stage 2- Assessment Evidence** |
| **Performance Tasks:**Vimeo PresentationField DayPoster DevelopmentPoster presentationPre-tests/Post-testsSelf Assessments | **Other Evidence:**TestsHomeworkClass Activities: labs, journals, etc…Formative assessmentsCommon assessment |
| **Stage 3- Learning Plan** |
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| **Month** | **Goals and items to complete** | **Suggested activities to support and assess learning** |
| September | * Give Pre-Test
* Begin background knowledge
* Clean hands/dirty hands technique
* Begin field trips
 | Practice clean hands/dirty hands and field data collection in classroom and on local river before going into the field. |
| October | * Begin process of background research
* Field trips finished by mid-October
* All samples to Celia by the end of October
* Show TEA lab PowerPoint
* Logo contest
 | Visit library to learn how to access primary and reliable resources for background.Field work rubric |
| November | * Develop problem questions
* Develop hypothesis
* Begin posters – place above on the poster
* Work on background
* Vimeo prep
* Save the date cards to board members/ administration
 | Hypothesis word activityTutorial on PowerPointPoster templateFill out background research plan worksheetIntroduce Vimeo and view some samplesData story |
| December | * Vimeo peer review
* Data back from Celia at the end of the month
 | Create the VimeoPractice the VimeoVideotape and post VimeoVimeo rubricPeer review othersData story, cont… |
| January | * Create tables and graphs of data
* Data analysis
* Posters finished and printed
 | Poster/scientific method rubricPractice Excel/Fathom graph making |
| February | * Model presentation by a scientist
* Practice presentations with internal peer review
* Poster session at Dartmouth
* Self-assessment
* Post-test
 | Self assessment rubricPresentation rubric |

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