# Phoenixville Area School District Understanding by Design (UbD) Science Template

**Grade Level &/or HS Subject: 11/ Chemistry** **Unit Name: Acids, Bases and Salts**

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">Overarching NGSS & PA Standards:<br><br>HS-PS1-1.Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.<br><br>PA-Chemical Reactions-Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…<br><br>• Ask questions and/or define problems<br>• Develop and/or use models<br>• Plan and/or carry out investigations<br>• Analyze and interpret data using computational thinking</td></tr>
<tr><td colspan="2">Meaning-Making</td></tr>
<tr><td>Students will understand that…<br>• The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (DCI-PS1.A: Structure and Properties of Matter)<br>• Models can be used to predict the relationships between systems or between components of a system (SEP: Developing and Using Models)<br>• How to use mathematical representations of phenomena to support claims (SEP: Using Mathematics and Computational Thinking)<br>• Acids, bases, and salts are part of our world in aspects such as cooking, cleaning, food, our bodies, and much more. An awareness of the properties of these chemicals allows our population to make responsible choices in the products we use, the foods we eat, what medicines we take, and what chemicals we place into and interact with in the environment.</td><td>ESSENTIAL QUESTIONS<br>Students will keep considering...<br>How does one characterize and explain acid-base reactions and make predictions about them?<br><br>How can models be used to simulate acidic/basic/buffer conditions in the real world?<br><br>How are graphical representations of large data sets constructed and used to identify relationships?<br><br>How can we analyze data with more precision and accuracy?</td></tr>
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| electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.<br><br>PA-Structure and Properties of Matter-Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.<br><br>**Which branch(es) of science apply:**<br><br>**LS PS E&SS** | | *When and how can mathematical ideas and acid-base data be generalized?*<br><br>*How do humans change the planet based on consumer choices of products they buy and use in the environment? (ESS.3.C)* |
| | ***Knowledge and Skills Acquisition*** | |
| | UNDERSTANDINGS<br>*Students will know…*<br>• *Different types of acids and bases (i.e., Arrhenius, Bronsted-Lowry, Lewis) are defined by different properties.*<br>• *Concentrations of $[H^+]$ and $[OH^-]$ are intimately related to pH and pOH and can describe the acidity or alkalinity of a system.*<br>• *An acid's or base's dissociation constant is related to the extent of ionization in a system.*<br>• *Titration is an effective model of acid-base behavior, and quantified measurements such as pH, pKa and $[H^+]$ can be determined from graphical analysis of such measurements.*<br>• *Buffers are mixtures of acids and bases that resist changes in pH and are natural components of our bodies and the environment, and essential for life.*<br>• *Salts can be acidic, basic, or neutral and their properties can be predicted by utilizing knowledge from the Periodic Table.* | *Students will be skilled at…*<br>• RST.9-10.7 Translating quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translating information expressed visually or mathematically (e.g., in an equation) into words. (HS-PS1-1)<br>• MP.2 Reasoning abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)<br>• MP.4 Modeling with mathematics. (HS-PS1-4),(HS-PS1-8)<br>• HSN-Q.A.2 Defining appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4),(HS-PS1-7),(HS-PS1-8) |
| | KEY VOCABULARY<br><br>Arrhenius acids/bases, Bronsted acids/bases, conjugate acids/bases<br>Mono/di/triprotic acids, Lewis acids/bases, ion-product constant<br>Neutralization, titration, acid/base dissociation constant<br>Salt hydrolysis, ionization, strong/weak acids and bases<br>Equivalence, acid-base indicator, buffers, pH/pOH | |

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| | | • SEP-Planning and Carrying Out Investigations: Planning and conducting an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3) |

| Stage 2 – Evidence | | |
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| **Evaluative Criteria** | ***Assessment Evidence*** | |
| Proficiency score<br><br>Lab report rubric<br><br>Presentation rubric | PERFORMANCE TASK(S):<br><br>• Modeling a neutralization reaction of acidic foods with baking soda-student discussion; relate to the generation of a gas by acids and metals (understanding properties of acids vs. bases)<br>• Conducting an investigation of household materials for pH, and the effect on our bodies and/or environment<br>• Student-led demonstrations of pH indicators and pH-meters with various materials. Students observe how pH indicators react to the acidity of their environment. (Comparing pH indicators with pH meters in terms of availability, efficiency, ease, cost, and accuracy)<br>• Groups of students will design a lab to compare shampoo used for normal, dry, and oily hair. Materials will be given to students, and the groups need to determine what data to gather, and how the data will be reported. Certain controls will be necessary, such as 1% shampoo preparations of solution and universal paper as the pH indicator. (Shampoos used for normal, dry, and oily hair are formulated by controlling the strengths and amount of the synthetic detergent (which includes a salt in its structure). The quantity of the active ingredient controls the "defatting" action, which removes oil from the hair. Group presentations will be shared with the class, and overall generalizations made from class data.<br>• Titration of a weak acid with a strong base. Students will be able to predict pH throughout the titration, identify when buffers are being made, when equivalence takes place, as well as qualitatively discuss salt hydrolysis. Students can verify results with mathematical calculations and perform error analysis. | Differentiation Considerations:<br><br>Cooperative group selection of members/different roles<br><br>Modified rubric with less analysis in conclusion<br><br>Enrichment: a study of materials beyond those items listed for acidity/alkalinity and the effect on us and the environment<br><br>English learners: Diagrams of acids and bases and hydrogen and hydroxide in concentrations of acid/base equilibriums<br><br>Enrichment: Students identify occupations in which people need to measure pH. Interested students select a local person in an occupation from the list and ask to interview that person about his or her use of pH measurement. Students write up a summary as if they were preparing a newspaper article of the interview. |

| Proficiency values<br><br>Point values<br><br>Lab report rubric<br><br>Proficiency score | OTHER EVIDENCE:<br>Cooperative Learning Drills: Identifying acids/bases, conjugates<br><br>Formative Assessments and Homework: Identifying acids/bases, conjugates, determining pH, pOH, concepts of strong acids and bases vs. weak<br><br>Laboratory Experiments: acid and base titrations, buffers<br><br>Common Summative test: Acids, bases, and salts | Differentiation Considerations:<br><br>Enrichment: activity about Lewis acids/bases and redox chemistry<br><br>Modified formative and common summative assessments (length, less MC choices, chunking of material, math concepts/equation given) |
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