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

## Grade Level \&/or HS Subject:

## Stage 1 Desired Results

## Overarching <br> NGSS \& PA <br> Standards:

PA: (Chemical
Reactions 3):
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.

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

Students will be able to independently

- Ask questions and/or define problems
- Plan and/or carry out investigations
- use their learning to analyze and interpret data according to computational thinking
- obtain, evaluate and communicate information (supported by evidence)

| Meaning-Making |  |
| :--- | :---: |
| Students will understand that chemical processes, their rates, and whether or not <br> energy is stored or released can be understood in terms of the collisions of <br> molecules and the rearrangements of atoms into new molecules, with consequent <br> changes in the sum of all bond energies in the set of molecules that are matched by <br> changes in kinetic energy. (PSl.B:Chemical Reactions) |  |
| Students will understand that in many situations, a dynamic and condition- <br> Students will keep considering all the <br> dependent balance between a reaction and the reverse reaction determines the <br> numbers of all types of molecules present. (PS1. B:Chemical Reactions) |  |
| Stussible factors that can affect the rate of <br> chemical reactions (i.e. concentration, <br> temperature, use of catalyst, etc.) |  |
| Students will understand that claims can be supported by using mathematical <br> representations of phenomena. (SEP: Using Mathematics and Computational <br> Thinking) |  |
| Students will keep considering what <br> stresses exist that change the equilibrium <br> position of a system (i.e. favors products <br> or favors reactants) |  |
| Students will keep considering that <br> antioxidants can slow down the oxidative <br> processes that occur in our environment <br> and in biological organisms. |  |

## Meaning-Making

Students will understand that chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (PSI.B:Chemical Reactions)

Students will understand that in many situations, a dynamic and conditiondependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (PS1. B:Chemical Reactions)

Students will understand that claims can be supported by using mathematical representations of phenomena. (SEP: Using Mathematics and Computational Thinking)

## ESSENTIAL QUESTIONS

Students will keep considering all the chemical reactions (i.e. concentration,
temperature, use of catalyst, etc.)
Students will keep considering what stresses exist that change the equilibrium position of a system (i.e. favors products

Students will keep considering that antioxidants can slow down the oxidative and in biological organisms.
rate at which a reaction occurs.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

## Which branch(es) of science apply:

LS PS E\&SS

Knowledge and Skills Acquisition
UNDERSTANDINGS
Students will know...

- how to construct a rate law which mathematically describes the rate of a reaction
- which factors affect the rate of a chemical reaction
- how concentration, temperature and pressure affect the position of equilibrium systems
- mathematical relationships of the equilibrium constant relate to the position of equilibrium
- how to interpret the magnitude of the solubility constant and relate it to the solubility of a compound
- when precipitation will occur, according to solubility rules and changes in concentration.
- That hills and valleys in a reaction mechanism progress curve can be interpreted as different rates and energies.
- The speed of a chemical reaction can be related to the value of the specific rate constant for a reaction


## KEY VOCABULARY

| Reaction rate | Reversible reaction | Common ion effect |
| :--- | :--- | :--- |
| Activation energy | Chemical equilibrium | First-order reaction |
| Collision theory | Le Chatelier's Principle | Intermediate |
| Catalyst / Inhibitor | Equilibrium constant | Mechanism |
| Equilibrium constant | Reaction Quotient | Elementary step(rate |

Students will be skilled at:

- using mathematical models which can be used to predict relationships between components in a system.(SEP: Developing and Using Models)
- Students will be skilled at planning and conducting an investigation collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of the data needed to produce reliable measurements and consider limitations on the precision of data (e.g., number of trials), and refine the design accordingly. (SEP: Planning and Carrying Out Investigations)
- Students will be skilled at creating a computational simulation of a chemical process.
- Abstract and quantitative reasoning (MP.2)
- Using units as a way to understand problems and guide the solution of multi-step problems; choosing/interpreting units consistently in formulas; choosing and interpreting the scale and the origin in graphs and displays (HSN-Q.A.1)

|  |  | - Choosing a level of accuracy appropriate to limitations on measurement when reporting quantities (HSN-Q.A.3) |
| :---: | :---: | :---: |
| Stage 2 - Evidence |  |  |
| Evaluative Criteria | Assessment Evidence |  |
| Lab report rubric <br> - Rubric for presentation <br> - Proficiency point values <br> - Student performance checks | PERFORMANCE TASK(S): <br> Students will interpret reaction progress mechanism graphs to identify key points of a chemical reaction. This will provide information to determine which parts of the reaction are slow, fast, and important to the overall success of a reaction. <br> Students will carry out investigations and apply information collected about rates of reaction to case studies involving real world scenarios of rates of reaction, such as the spoiling of food, the development of mold over time, the decomposition of household products and medicine, etc. Students can use this information to present their findings to the class and provide solutions to the prevention of unwanted natural phenomena. <br> Students will carry out investigations that simulate real world equilibria reactions, such as reversible reactions that occur in our bodies, i.e. acidosis/alkalosis, using different stresses as temperature, pressure and concentration changes to interpret those results. <br> Students will solve various types of problems, collaboratively and individually, with varying amounts of stresses to determine in which direction a reaction will shift. The analyses of these problems can be related to chemical reactions that happen in our environment and be able to predict these changes if those stresses would occur. | Differentiation Considerations: <br> - Choice of problems (scaffolding, chunking) <br> - Consideration of role in groupwork and group presentation <br> - Consideration of how groups are formed <br> - Supplementary guided worksheets <br> - Modified rubrics |

What criteria will
be used in each
assessment
to evaluate attainment of the desired results?

- Point values
- Proficiency scores
- Lab report rubrics

OTHER EVIDENCE:
Differentiation Considerations:

- student performance checks
- Graphing exercises of data
- lab reports
- problem sets
- teacher summatives (quizzes)
- common summatives (tests)
- Scaffolded questions
- Modified assessments
- Modified lab report rubrics
- Modified proficiency score baseline
- Enrichment questions:(e.g. How would a first-order graph for a reaction look different for a reaction that is reversible? (It never reaches zero concentration)

