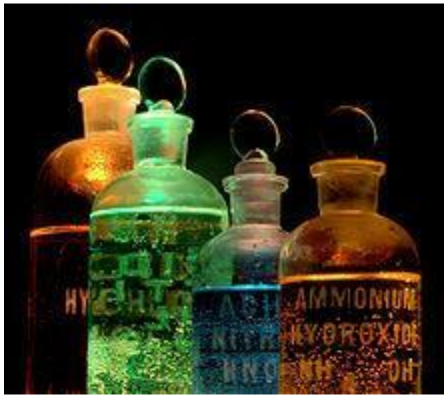
Secaucus Board of Education

PSI Chemistry

Course Code: 4310, 4320, 4101

Science Department



Born on August 2016

Aligned to the NJSLS – Science (2014), Technology (2014), 21st Century Life and Careers (2014), ELA (2016) and Mathematics (2016)

Adopted by the Secaucus Board of Education on August 25, 2016

District Equity Statement

The Board of Education directs that all students enrolled in the schools of this district shall be afforded equal educational opportunities in strict accordance with the law. No students shall be denied access to or benefit from any educational program or activity or from a co-curricular or athletic activity on the basis of the student's race, color, creed, religion, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, gender identity or expression, socioeconomic status, or disability. The Board directs the Superintendent to allocate faculty, administrators, support staff members, curriculum materials, and instructional equipment supplies among and between the schools and classes of this district in a manner that ensures equivalency of educational opportunity throughout this district. The school district's curricula in the following areas will eliminate discrimination, promote mutual acceptance and respect among students, and enable students to interact effectively with others, regardless of race, color, creed, religion, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, gender identity or expression, socioeconomic status, or disability:

1. School climate/learning environment
2. Courses of study, including Physical Education
3. Instructional materials and strategies
4. Library materials
5. Software and audio-visual materials
6. Guidance and counseling
7. Extra-curricular programs and activities
8. Testing and other assessments.

Excerpt from Secaucus Board of Education, Policy 5750, Edited September 2016

Chemistry Curriculum

This course represents the first year in a comprehensive two year sequence of chemistry; students who elect to go on to the second year course, PSI AP Chemistry, will be prepared to take the AP Exam at the end of that course.

PSI Physics and Algebra are prerequisites to this course; the work done in PSI Physics is applied and expanded upon to explain macroscopic phenomenon through an understanding of the microscopic. The course is both quantitative and qualitative in nature, so mathematics will often be applied to the solving of problems.

Throughout the year, students will be involved in problem-solving activities on an individual, small group and large group basis. Through this process the ability to read and understand problems, break them down into their component parts and then create and present solutions will be developed.

These same skills will be developed with activities in the chemistry laboratory. In that case, problem solving will be done in real time with hands-on problems. Through this process both analytical techniques as well as technological capability will be developed.

Integral to the teaching of this course is the use of SMART boards, and notebooks. Many of the curricular materials that support this course require that technology in order to develop effective learning on the part of students.

Students who have successfully completed this course will be well prepared for PSI Biology. In fact, the last two chapters of this course apply the principles of chemistry to biology. In biology, a similar approach is taken of developing a microscopic understanding in order to explain macroscopic phenomena.

<u>Course Content Outline</u>

1. **Atomic Structure (Review from Physics)**
    a. The Wave Nature of Light
    b. The Double slit Experiment
    c. Photons and the photoelectric effect
    d. The Rutherford model of the atom
    e. The Nature of Matter
    f. Dalton's Atomic Theory
    g. Subatomic Particles
    h. Bohr model of the atom
    i. Rutherford Model
    j. Ions, Isotopes, and Average Atomic Mass
2. **Models of the Atom and the Periodic Table**
    a. Emission Spectra and the Bohr Model of the Atom
    b. The Quantum Mechanical Model of the Atom
    c. Electron configurations and the Periodic Table

3. Periodic Trends

a. Review of Coulombic Attraction (from Physics)

b. Periodic trends

    i. Atomic size

    ii. Electronegativity

    iii. Ionization Energy

c. Valence electrons and periodic trends

4. Ionic Bonding and Ionic Compounds

a. Formation of Cation and Anions

b. Formation of Ionic Compounds

c. Properties of Ionic Compounds

d. Naming of Ionic compounds

Covalent Bonding and Molecular Compounds

e. Covalent bonding

f. Properties of Ionic Compounds and Molecular Compounds

g. Naming of molecules

h. Lewis Structures

i. Multiple bonds

j. Formal Charge*
k. Resonance structures*
l. Exceptions to the octet rule*
m. Molecular shapes (the VSEPR model)*
n. Polarity of molecules and symmetry

5. Moles and the Periodic Table

a. Avogadro's Number
b. Atomic Mass Unit
c. Atomic Weight in AMU versus grams of N_A atoms
d. Converting between number of atoms and moles of an element
e. Converting between volumes and moles of gas at STP
f. Converting between mass and moles of an element
g. Empirical Formulae
h. Molecular Formulae

6. Chemical Reactions

a. Balancing chemical equations
b. Precipitation reactions
    i. Use of solubility tables to predict reaction

    ii. Use of activity series to predict reaction
    iii. Net ionic equations
  c. Oxidation-Reduction reactions
    i. Synthesis reactions
    ii. Decomposition reactions
    iii. Combustion Reactions – completing and balancing

7. Gases, Liquids and solids

  a. The ideal gas law
  b. Gas density and molar mass
  c. Dalton’s law of partial pressures
  d. Kinetic – molecular Theory
  e. Average molecular speeds in relation to mass and temperature
  f. Graham's law of Effusion
  g. Non-ideal gases

8. Intermolecular Forces

  a. Dipole-Dipole
  b. London Dispersion Forces
  c. Hydrogen Bonding
  d. Phase diagrams

e. Critical and triple points

f. Predicting the characteristics of a material from its molecular formula

   i. Boiling points

   ii. Vapor pressure

   iii. Volatility

g. Structure of solids and lattice energy

9. Thermochemistry and Thermodynamics

a. First Law: Conservation of Energy and its implications

b. Exothermic vs. Endothermic processes

c. Energy as a state function

d. Enthalpy of phase changes: fusion and vaporization

e. Enthalpy of temperature changes

f. Calorimetry

g. Specific Heats

h. Enthalpy changes during reactions

i. Hess's Law of Heat Summation

j. Standard enthalpy and enthalpies of reaction and formation

k. Second Law: Entropy and its implications

l. Standard entropy

m. Entropy of reactions

n. Gibbs Free energy and spontaneity

o. Free energy and temperature

10. Solutions

a. Concentration units

b. Saturated solutions

c. Factors affecting solubility

d. Colligative properties

11. Chemical Kinetics

a. Reaction rates

Dependence of rate on concentration

Dependence of rate on concentration: the Collision Model

First-order and Second-order reactions

Potential energy diagrams: Activation energy and ΔH

Catalysis

12. Chemical Equilibrium

a. The equilibrium constant: forward and reverse rates of reaction

b. Calculating K_c
c. Le Chatelier's Principle
d. The effects of changes in
    i. Pressure
    ii. Concentration
    iii. Temperature (in exothermic and endothermic reactions)

13. Acid-Base Equilibrium

a. The Arrhenius model
b. The Bronsted-Lowry model
c. Autoionization of water and the pH scale
d. Strong acids and Strong bases
e. Weak acids and Weak bases

14. Oxidation-Reduction Reactions

a. Assigning oxidation numbers
b. Determining oxidation numbers in a compound
c. Identifying oxidized and reduced species
d. Balancing oxidation-reduction reactions

Extra end of year preparation for Biology:

15. Properties of Water

a. The effects of Hydrogen Bonding
b. High specific heat: Moderation of temperature
c. Polar solvent: role in life
d. Density of solid versus liquid form: Insulation due to Floating Ice
e. Adhesion and Cohesion
f. Acids and bases

16. Organic Chemistry

a. Introduction to organic chemistry
b. Carbon and its ability to form four bonds
c. Classification of organic compounds: Alkanes, Alkenes and Alkynes
d. Functional groups
e. Amino Acids
f. Aromatic compounds
g. Naming organic compounds
h. Polymers

Laboratory demos and practical

The laboratory work – This includes individual and group work. Colorimetry, calorimetry and electrochemistry experiments are performed in groups of two.

1. Observing Chemical Reactions
2. Atomic mass of 'beanium'
3. Flame test – Identifying metal ions in compounds
4. Formation of ionic compounds- Formula of ionic compounds
5. Molecular geometry- A hands on activity using molecular model set-VSEPR theory
6. Weighing as means of counting- Mole calculations
7. Empirical formula of copper sulfate hydrate
8. Single and double replacement reactions-Activity series
9. Classifying chemical reactions- Analyzing and predicting reaction products
10. Double replacement reactions- Solubility of the products and net ionic equations
11. Limiting reagent- reaction stoichiometry and yield of a reaction
12. Ideal gas law- Mass of helium in the balloon
13. Heat of reactions and Hess's law- Small scale calorimetry
14. Depression in freezing point and Molar Mass determination

Guiding Principles

- Science Sequence – A fundamental principle of the Progressive Science Initiative (PSI) is that the courses are taught in the sequence of physics-chemistry-biology. This sequence allows students to learn the sciences in a way which minimizes memorization and maximizes understanding. In this sequence, each science becomes the foundation for the next.

- Social Constructivism – The core element of the teaching-learning process is an ongoing cycle of brief direct teaching episodes followed by student problem solving, often in groups of 4-5. Problems are designed to engage students in collaborative application of learned principles, maintain them in their zone of proximal development while developing their skills in collaborative teamwork. The use of SMART Responders has strengthened this component significantly.

- SMART Notebooks and course materials – All PSI units have been developed by teachers at the Bergen County Technical High School in Teterboro. Lessons are taught in SMART Board-equipped classrooms using SMART notebook technology. All curricular materials are hosted on www.njpsi.org, a site created and maintained by NJCTL. Free access to these materials is available to all students and teachers of science and mathematics for non-commercial purposes (student access to assessments is, of course, restricted). The site is constantly being updated and expanded by a cadre of NJCTL employees as well as participating PSI students and teachers.

Disclaimer

The pacing and topics presented in this curriculum may be modified at the teacher's discretion on the basis of, but not limited to, academic level of the course, student performance, student needs, and school schedule.

Course Modifications (ELLs, Special Education, Gifted and Talented)

The course instructor will determine, with the assistance of guidance counselors, teacher assistant/aides, and/or special education teachers, what modifications will be made for his/her students. Such examples of modifications can include, but not be limited to:

- Extended time as needed
- Modification of tests and quizzes
- Preferential seating
- Alternative/Formative assessment (projects)
- Effective teacher questioning (ranging from simple recall to higher order critical thinking questions)
- Supplemental materials
- Cooperative learning
- Teacher tutoring
- Peer tutoring
- Differentiated Instruction

Interdisciplinary Connections

The following NJSLS for ELA, Mathematics, College and Career Readiness, and Technology depict what standards align to the science standards taught in this PSI Physics Course.

NJSLS - ELA/Literacy:

- ❖ RST.9-10.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
- ❖ RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- ❖ RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or

performing technical tasks, attending to special cases or exceptions defined in the text.

- ❖ RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.
- ❖ RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
- ❖ RST.9-10.6. Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
- ❖ RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- ❖ RST.9-10.8. Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- ❖ RST.9-10.9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- ❖ RST.9-10.10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
- ❖ WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
- ❖ WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

NJSLS - Mathematics:

- ❖ A.SSE.1 Interpret expressions that represent a quantity in terms of its context.
- ❖ A.SSE.2 Use the structure of an expression to identify ways to rewrite it.
- ❖ A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- ❖ A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations

of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

- ❖ A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- ❖ A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ❖ A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- ❖ A.REI.4 Solve quadratic equations in one variable
- ❖ A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- ❖ N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- ❖ N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- ❖ N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a non-zero rational number and an irrational number is irrational.
- ❖ F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- ❖ F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- ❖ F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- ❖ F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- ❖ F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
- ❖ F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- ❖ F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)
- ❖ F.BF.1 Write a function that describes a relationship between two quantities.
- ❖ F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.

- F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
- F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.
- S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
- S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages
- S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
- S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
- S.ID.9 Distinguish between correlation and causation.

NJSLS – Technology:

- 8.1.12.A.1 Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
- 8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
- 8.1.12.A.3 Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to

a problem or issue.

- 8.1.12.A.4 Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
- 8.1.12.A.5 Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

NJSLS – 21st Century Life and Careers:

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Unit Lesson Plan – Atomic Origins			
16 days	**Time Frame:**	SBOE faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.		**New Jersey Student Learning Standard(s) – Science**	

Essential Questions

1. Where did matter come from?

Knowledge & Skills

By the end of this unit, students will be able to:	By the end of this unit, students will know:
● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	● Each atom has a charged substructure consisting of a nucleus, surrounded by electrons. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does

	not change in any nuclear process.

Assessment

After a brief lesson to introduce concepts, students will be questioned on these concepts. The teacher will demonstrate the problem solving skills needed for the topic and again, students will be questioned. Students will convene in small groups to complete problems. Then some students may volunteer to write their solutions on the board and explain their problem solving process.

Pacing Guide

CW/HW	Presentation	Topic	Day
Syllabi, Lab Safety Contract Practice Questions 6-10	Slides 4-26 Practice Questions 1-5	The Big Bang	1
Lab Safety Quiz	Lab Safety Presentation	Lab Safety	2

Lab Analysis	Lab	Chemical Reactions Lab	3
Practice Questions 16-20	Slides 27-46 Practice Questions 11-15	Electrons & Protons	4
Practice Questions 36-41	Slides 47-71 Practice Questions 21-25	The Nucleus – Nucleus & Neutrons	5
Practice Questions 42-50	Slides 72-81 Practice Questions 26-35	The Nucleus - Nomenclature	6
Practice Questions 62-64	Quiz Slides 82-92 Practice Questions 51-53	Formation of Elements – Binding Energy	7
Practice Questions 65-72	Slides 93-112 Practice Questions 54-61	Formation of Elements – Fusion/Fission	8

Practice Questions 81-86	Quiz Slides 113-119 Practice Question 73-76	Isotopes – Atomic Symbols	9
Activity Analysis	Activity	Atomic Masses Activity	10
Practice Questions 87-90	Slides 120-127 Practice Questions 77-80	Isotopes – Atomic Mass	11
Practice Questions 96-100	Slides 128-139 Practice Questions 91-95	Radioactive Decay	12
Practice Questions 106-110	Slides 140-145 Practice Questions 101-105	Half-Life	13
MC/FR Review Questions	Quiz Multiple Choice Review	Review	14
MC/FR Review Questions	Free Response Review	Review	15

	Unit Test	Test	16

Unit Lesson Plan – Atomic Structure			
12 days	**Time Frame:**	SBOE faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS4-3 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.		**New Jersey Student Learning Standard(s) – Science**	
Essential Questions			
2. How has our understanding of the structure of matter changed?			

Knowledge & Skills	
By the end of this unit, students will be able to: ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)	By the end of this unit, students will know: ● Electromagnetic radiation and matter can be modeled as a wave or as particles. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) ● A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

Assessment
After a brief lesson to introduce concepts, students will be questioned on these concepts. The teacher will demonstrate the problem solving skills needed for the topic and again, students will be questioned. Students will convene in small groups to complete problems.

Then some students may volunteer to write their solutions on the board and explain their problem solving process.
(What is the sequence of activities, learning experiences, etc, that will lead to desired results (the plan)?

CW/HW	Presentation	Topic	Day
Practice Questions 14-18	Slides 4-27 Practice Questions 1-5	Bohr Model – Emission Spectra	1
Practice Questions 19-26	Slides 28-46 Practice Questions 6-13	Bohr Model – Energy	2
	Lab	Flame Test	3
Practice Questions 35-39	Quiz 1 Slides 47-56 Practice Questions 27-31	Quantum Mechanics – Wave Nature of Matter	4

Practice Questions 40-42	Slides 57-78 Practice Questions 32-34	Quantum Mechanics – Quantum Theory	5
Practice Questions 51-52	Slides 79-99 Practice Questions 43-44	Quantum Model – Quantum Numbers	6
Practice Questions 53-58	Slides 100-114 Practice Questions 45-50	Quantum Model – Quantum Numbers	7
Practice Questions 71-77	Quiz 2 Slides 115-134 Practice Questions 59-64	Electron Configurations - Rules	8
Practice Questions 78-84	Slides 135-154 Practice Questions 65-70	Electron Configurations – Electron Configurations	9
	Quiz 3 MC/FR	Review	10
	MC/FR	Review	11

	Test	Test	12

Unit Lesson Plan – The Periodic Table			
11 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
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 the atoms.		**New Jersey Student Learning Standard(s) – Science**	
Essential Questions			
3. How is the Periodic Table derived from the 3 quantum numbers plus spin? 4. How does the placement of an element on the Periodic Table relate to its chemical and physical properties? 5. How does knowing trends on the Periodic Table help scientists predict the properties of the representative elements?			

Knowledge & Skills	
By the end of this unit, students will be able to: • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3) • Identify the group and period of an element and characterize the general properties of the following sets of elements: alkali metals, alkaline earth metals, transition elements/metals, carbon group, oxygen group, halogens, noble gases, lanthanides, actinides. • Connect an element's location on the periodic table to its electron configuration. • Describe periodic trends of atomic radius, first ionization energy, and electronegativity, connect these trends to Coulomb's Law and effective nuclear charge and explain reasons for the variations in these trends. • Identify an element as a metal, nonmetal, or metalloid based on its location on the periodic table.	By the end of this unit, students will know: • 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. (HS-PS1-3) • Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. • Each element has properties that affect its behavior and interaction with its environment. These properties can be predicted using the periodic table as a model. • Periodic trends include Atomic Number and Atomic Weight, which increase as one moves down and to the right on the periodic table; Atomic Radius and Metallic Properties,

	which increase as one moves down and to the left on the periodic table; and Electron Affinity, Electronegativity, and Ionization Energy, which increase as one moves up and to the right of the periodic table. ● Understanding the periodic trends allows us to make predictions about the properties of individual elements based on their position on the periodic table. ● There are some exceptions to the rules of periodic trends

Assessment

After a brief lesson to introduce concepts, students will be questioned on these concepts. The teacher will demonstrate the problem solving skills needed for the topic and again, students will be questioned. Students will convene in small groups to complete problems. Then some students may volunteer to write their solutions on the board and explain their problem solving process.

Pacing Guide

HW	Presentation and CW	Topic	Day

Practice Questions 5-8; 13-16	Slides 4-32 Practice Questions 1-4; 9-12	The Periodic Table	1
Practice Questions 20-22; 27-30	Magnesium Sodium Demo Slides 33-55 Practice Questions 17-19; 23-26	Periodic Table and Electron Configurations	2
Practice Questions 35-38	Quiz 1 Slides 56-69 Practice Questions 31-34	Electron Configurations and Stability	3
Practice Questions 43-46; 51-54	Slides 70-107 Practice Questions 39-42; 47-50	Effective Nuclear Charge	4

Practice Questions 59-62	Slides 108-120 Practice Questions 55-58	Atomic Radius	5
Practice Questions 67-70	Quiz 2 Slides 121-141 Practice Questions 63-66	Ionization Energy	6
Practice Questions 75-78; 83-86	Slides 142-162 Practice Questions 71-74; 79-82	Electronegativity and Metallic Character	7
Lab Analysis	Quiz 3	Metallic Character and Periodic Trends Lab	8
	Quiz 4 MC/FR	Review	9
	MC/FR	Review	10
		Test	11

Unit Lesson Plan – Ionic Bonding and Ionic Compounds			
8 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.		**New Jersey Student Learning Standard(s) – Science**	
Essential Questions			
6. How does the electron configuration of an atom determine what type of bond will form? 7. How does an ionic bond form? 8. What are the common properties of ionic compounds? 9. How do scientists write the names and formulas for ionic compounds?			

Knowledge & Skills	
By the end of this unit, students will be able to: • Determine the number of valence electrons given the group numbers • Determine the most likely charge of a cation or anion based on the number of electrons gained or lost • Describe the formation of an ionic bond • Decide what elements will form ionic bonds given electro negativities • Write formulas for ionic compounds using least common multiple so that overall charge is zero • Name binary ionic compounds (ending in –ide) • Write names and formulas for ionic compounds containing a transition metal (using the stock naming system) • Write names and formulas for ternary ionic compounds that contain a polyatomic ion (and transition metal)	By the end of this unit, students will know: • Valence electrons are the electrons in the highest occupied energy level • Valence electrons determine the chemical and physical properties of an element • Metals tend to lose valence electrons to become stable cations • Nonmetals tend to gain valence electrons to become stable anions • When the difference in electronegativity between two atoms is greater than 1.7, the more electronegative atom removes an outer electron from the less electronegative atom • Oppositely charged ions are held together by electrostatic attraction (ionic bond) • Ionic bonds form when electrons are transferred from a metal to a nonmetal • Ionic compounds are crystalline solids at room temperature, they have high melting points, and they conduct electricity in their molten states or when in aqueous solution • Ionic compounds are overall electrically neutral and crystalline solids form so that the

	overall compound has no net charge ● Because of their d and f block orbitals, most transition metals can form more than one stable cation ● A polyatomic ion is a group of atoms covalently bonded that have a charge but act like a single ion

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Quiz 1: Ions Quiz

Lab 1: Names and Formulas of Ionic Compounds Lab

Lab 2: Virtual Lab: Ionic Bonding and Ionic Formulas

Unit Test: Ionic Bonding and Ionic Compounds

Pacing Guide

Homework	Classwork	Topic	

			Day
Ch Probs 5 – 8, 13 – 16; MC 1 – 19	Ch Probs 1 – 4, 9 – 12	Periodic Table Review Valence Electrons Ions & Ionic Bonding	1
Ch Probs 27 – 36 MC 20 – 23	Ch Probs 17 – 26 Formula Writing I: Binary Compounds	Properties of Ionic Compounds Ionic Compound Formula	2
Finish any lab conclusion questions; catch up on previous HW	**Quiz 1: Ions Quiz** Computer Based Lab Procedure	Virtual Lab: Ionic Bonding and Ionic Formulas	3
Ch Probs 48 – 58; MC 24 – 48	Ch Probs 37 – 47 Formula Writing III: Compounds with transition metals	Naming Binary Ionic Compounds Names and formulas that include transition metals	4
Ch Probs 69 - 78 MC 49 – 63	Ch Probs 59 – 68 Formula Writing II: Compounds with Polyatomics	Polyatomic Ions Formulas and Names of ternary ionic compounds	5

Finish Lab Analysis Questions	Lab Procedure	Lab: Names and formulas of ionic compounds	6
Study for Quest	Review MC Odds or Evens and Chapter Problems (class work) as necessary More Practice (3 pgs in Ionic Compound Formula Writing)	Review	7
	Ionic Bonding Test	Test	8

Unit Lesson Plan – Covalent Bonding			
15 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on		**New Jersey Student Learning Standard(s) – Science**	

the patterns of electrons in the outermost energy level of atoms. (Types & Number of Bonds)	

Essential Questions
1. What holds matter together?

Knowledge & Skills	
By the end of this unit, students will be able to: ● Determine the type of bonding present in a compound	By the end of this unit, students will know: ● The properties of covalent network solids ● The properties of molecular solids

Assessment
After a brief lesson to introduce concepts, students will be questioned on these concepts. The teacher will demonstrate the problem solving skills needed for the topic and again, students will be questioned. Students will convene in small groups to complete problems. Then some students may volunteer to write their solutions on the board and explain their problem solving process.

Pacing Guide			
CW/HW	Presentation	Topic	Day
1-5; 6-10	Slides 4-16	Types of Bonds and Covalent Compounds	1
11-18; 19-26	Slides 17-24	Naming Covalent Compounds	2
	Quiz 1 Slides 25-30	Lewis Dot Structures	3
27-31; 32-36	Slides 31-50	Lewis Structures	4
37-41; 42-46	Slides 51-64	Double Bonds	5

47-51; 52-56	Slides 65-70	Diatomic Elements	6
57-58; 59-60	Slides 71-76	Resonance Structures*	7
61-64; 65-68	Slides 77-89	Polyatomic Ions	8
69-73; 74-78	Slides 90-101	Exceptions to Octet	9
79-83; 84-88	Quiz 2 102-112	Electron Domain Geometry	10
89-92; 93-96	Slides 113-129	Molecular Geometry	11
97-98; 99-100	Slides 130-136	Hybridization Theory*	12

101-105; 106-110	Slides 137-153	Polarity	13
	Quiz 3 MC/FR	Review	14
	Test	Test	15

Unit Lesson Plan – Intermolecular (IM) Forces			
9 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions

At a molecular level, how do gases, liquids and solids compare?

What role do temperature and IM forces play in the determining the physical state of a substance?

What is meant by the boiling point of a liquid?

How do the nature and strengths of the IM forces between molecules impact on the boiling point?

What is the vapor pressure of a liquid and how does the nature and strengths of the IM forces between molecules affect the vapor pressure? How does the boiling point of a substance relate to its vapor pressure? What does it mean for a liquid to be volatile or to evaporate? Why is evaporation a cooling process? What are phase diagrams and what do they represent?

Knowledge & Skills	
By the end of this unit, students will be able to: ● Compare and contrast the physical properties of gases, liquids and solids as they relate to the IM forces and the relative strengths of intermolecular attractive forces. ● Identify the intermolecular attractive forces (dipole-dipole, London dispersion and hydrogen bonds) that exists between molecules or ions based on their composition and molecular structure and compare the relative strengths of these forces. ● Outline the relationship between the strength of intermolecular forces present and a substance's volatility, viscosity and surface tension. ● Predict the relative boiling points of different substances from an understanding of their intermolecular forces. ● Describe all phase changes as either endothermic or endothermic processes. ● Be able to draw and interpret a phase diagram and be able to determine	By the end of this unit, students will know: ● The 2 fundamental differences between states of matter are the distance between particles and the particles' freedom to move. ● Solids and liquids are considered condensed phases of matter. ● The state of a substance at a particular temperature and pressure depends on two major factors: the strength of the intermolecular forces that hold molecules together and the kinetic energy of the molecules. ● The attractions between molecules, intermolecular forces, are not nearly as strong as the intramolecular attractions that hold

the phase change a substance goes through as temperature or pressure are varied. ● Use the slope of the melting curve to predict whether the liquid or the solid phase of the substance is denser. ● Define critical temperature, critical pressure, vapor pressure, normal boiling and melting point, critical point and triple point. ● Explain how water's phase diagram differs from most other substances. ● Classify solids based on their bonding/intermolecular forces and understand how differences in bonding relate to physical properties.	compounds together. ● Without intermolecular forces (IMF's), all substances would behave like ideal gases, there would be no liquids or solids. ● Temperature is directly proportional to the average kinetic energy of the molecules that make up a substance. ● The boiling point of a substance refers to the temperature at which the molecules' energy overcomes the intermolecular forces binding them together. ● The higher the boiling point of a substance, the stronger the intermolecular forces. ● The concept of polarizability and know how it relates to dispersion forces. ● The relationship between physical properties viscosity and surface tension and a substance's intermolecular forces. ● That phase changes are transformations from one phase to another. ● Melting, sublimation and vaporization are endothermic process and freezing, deposition and condensation are exothermic processes ● The vapor pressure of a liquid indicates the tendency of the liquid to evaporate and is inversely proportional to the strength of its intermolecular forces. The greater the IM forces present the lower its vapor pressure. ● A phase diagram depicts the equilibria that

	exist between the solid, liquid and gas phases of substances as a function of temperature and pressure. ● A line indicates the equilibria between any two states. ● The normal melting or boiling point is at 1 atm of pressure. ● The point on the diagram when all three phases are in equilibrium is called the triple point. ● Know the difference between crystalline and amorphous solids.

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Intermolecular Forces Quiz

Vapor Pressure Quiz

Phase Diagrams Quiz

Intermolecular Forces Test

Other assessments on the NJCTL website are optional and can be used as needed.			
Pacing Guide			
Homework**	Classwork	Topic	Day
5-8,11-12	1-4,9-10	States of Matter and Intermolecular Forces	1
19-21	15-18	Types of Intermolecular Forces: Dipole-Dipole and London Dispersion Forces	2
31-40	22-30	Types of Intermolecular Forces: Hydrogen bonding and Ion-dipole	3
43-45	41-42	Intermolecular Forces Quiz + IMFs and Physical Properties and Phase Changes	4

51-56	46-50	Vaporization/Vapor Pressure	5
65-73	57-64	Vapor Pressure Quiz + Phase Diagrams	6
78-81	74-77	Phase Diagrams Quiz + Types of Solids	7
		Exam Review	8
		Intermolecular Forces Test	9

Unit Lesson Plan – Mole Calculations			
9 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem - solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions
How many atoms are there in 1 g of sugar? What is the mass of 100 mL of Hydrogen?

What is the percent composition of table salt?

How do we determine the formula of a compound from the percent composition?

Knowledge & Skills

By the end of this unit, students will be able to:

- Solve converting moles – particles, mole-mass, mole –volume of different atoms and molecules.
- Calculate percent composition of substances and then to calculate the empirical and molecular formula of it.

By the end of this unit, students will know:

- Understand the relationship between Avogadro number and mass of a substance.
- List practical applications of mole-mass and mole-volume calculations

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Quiz – mole-particles

Quiz- mole-mass in grams

Quiz-mole-volume

Lab – counting particles Quiz- percent composition, empirical and molecular formula Chapter test Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
6-18	1-5 questions	Introduction to Avogadro number Mole and particles connection	1
26-36	19-25	Molar mass of elements and compounds Mole to molar mass connection	2
37-51	Group work solving problems Quiz 1 & 2 can be given together	Mole to molar volume at STP Mole to molar volume and mixed type conversions	3

56-74	Group work 52-55	Percent composition of compounds Empirical formula	4
64-74	Quiz 3	Empirical formula and Molecular formula	5
	Quiz 4 - %composition, empirical and molecular formula	Homework review	6
	Test - Chapter	Mole calculations	7
	All topics covered so far	Midterm Review	8
	All topics covered so far	Midterm exam	9

Unit Lesson Plan – Chemical Reactions			
13 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.[Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]			**New Jersey Student Learning Standard(s) – Science**

Essential Questions
How do we describe a chemical reaction? Why there is a need to balance a chemical reaction? How many different reactions are there? What are double replacement reactions? What are spectator ions? What is a net ionic equation?

Knowledge & Skills	
By the end of this unit, students will be able to: ● Write and interpret balanced chemical equations ● Identify the type of a reaction ● Predict products for a reaction ● Write balanced net ionic equations	By the end of this unit, students will know: ● Chemical reactions can be represented with chemical equations ● Balancing chemical equations obeys the Law of Conservation of Mass ● The types of chemical reactions ● Reactions can be expressed with Net Ionic Equations

Assessment
During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below. Quiz- Reactions and balancing reactions Quiz – Precipitate reactions Quiz-Types of reactions

Lab – Precipitation reactions Lab – Single replacement reactions Lab – acid and base reactions Chapter test Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Skeleton equations and balancing equations	1
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Precipitate reactions and solubility rules	2
Questions from NJCTL packet	Homework review Questions within slides, from NJCTL packet and	Quiz – balancing reactions	3

	from chemistry textbook	Review of precipitate reactions and solubility rules Net ionic equations	
Questions from NJCTL packet	Lab	Lab – precipitate reactions	4
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Oxidation-reduction reactions – assigning oxidation numbers	5
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Oxidation-reduction – identifying the species oxidized and the species reduced, and types of reactions	6
Questions from NJCTL packet	Homework review and lab	Homework review Lab – single replacement reactions	7

Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Combination, decomposition and combustion reactions	8
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Acid and base neutralization reactions	9
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Bronsted-Lowry definition of acids and bases Everyday examples of acids and bases	10
Questions from NJCTL packet	Lab	Lab – acid and base neutralization reactions	11
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	How to recognize the type of reaction	12
	Chapter test	Chapter test	13

Unit Lesson Plan – Stoichiometry			
7 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions
How do we interpret a chemical equation? What is stoichiometry? What is a limiting reagent?

How do we calculate the yield in a reaction?

Knowledge & Skills

By the end of this unit, students will be able to:	By the end of this unit, students will know:
● Interpret balanced chemical equations ● Calculate the amount of reactant needed ● Determine the limiting reagent and excess reagent ● Calculate theoretical yield and percent yield	● Balancing chemical equations obeys the Law of Conservation of Mass ● A balanced chemical reaction is like a recipe ● A limiting reagent is the one that runs out first ● Reactions usually do not go 100% to completions

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Quiz- mole-mole and mass-mole relationships

Quiz – limiting reagent

Lab – limiting reagent and percent yield

Chapter test

Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide			
Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Interpreting balance reactions and mole-mole relationships	1
Questions from NJCTL packet	Homework review Questions within slides, from NJCTL packet and from chemistry textbook	Homework review Mole – mole and mole – mass relationships	2
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and	Quiz – mole and mole – mass relationships	3

	from chemistry textbook	Limiting reagent and excess reagent	
Questions from NJCTL packet	Homework review Questions within slides, from NJCTL packet and from chemistry textbook	Homework review Percent yield	4
Questions from NJCTL packet	Lab	Lab – limiting reagent and percent yield	5
Questions from NJCTL packet	Lab Questions within slides, from NJCTL packet and from chemistry textbook	Lab – limiting reagent and percent yield Review	6
	Chapter test	Chapter test	7

Unit Lesson Plan – Gases			
12 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

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.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions

How does the kinetic-molecular theory (KMT) help us understand gas behavior at the molecular level?

What physical characteristics of gases distinguish them from liquids and solids?

What is gas pressure and how do we measure it?

What is the nature of the empirical relationship between the volume, pressure, temperature and quantity of gases?

Why do most gases come very close to obeying the ideal gas law at ordinary temperatures and pressures?

What is the relationship between a gas's density and its molar mass?

How do we use Dalton's Law of Partial Pressures to determine the pressure of a gas in a gas mixture?

How do we describe the movement of gases through tiny openings (effusion) and through another substance (diffusion)?

How do we use the van der Waals equation to accurately account for the behavior of real gases at high pressures and low temperatures?

Knowledge & Skills

By the end of this unit, students will be able to:

- Convert between the Celsius and Kelvin temperature scales.
- Define pressure and interconvert between the common units of pressure, Pascal, psi, atm, mmHg and torr.
- Use the Gas laws: Boyle's, Charles's, Avogadro and Gay-Lussac's to solve for an unknown variable at a new set of conditions.
- Use the Combined and Ideal Gas Law to solve for an unknown variable.
- Complete gas stoichiometry problems at standard and other conditions.
- Interconvert between a gas's density and its molar mass.
- Use Dalton's Law of Partial Pressure to determine the partial pressure of a gas collected over water.
- Use Graham's Law of Effusion to solve for the unknown molar mass of a gas given the ratio of the unknown gas to a known gas' velocity.

By the end of this unit, students will know:

- How KMT explains gas behavior that we see on the macroscopic level with what we can't see on the microscopic level.
- How the characteristic behavior of gases is explained through the minimal interactions between gas molecules and their low densities.
- What gas pressure is and how to it is measured.
- How a barometer and a manometer work.
- The conditions that define STP.
- The inverse relationship between pressure and volume (Boyle's' Law), the direct

Outline the conditions in which gases act most ideally.	relationship between volume and temperature (Charles's Law), the direct relationship between volume and number of moles (Avogadro's Law) and the direct relationship between pressure and temperature (Gay-Lussac's Law). • How the direct relationship between a gas's density and its molar mass allows you to solve for one given the other. • How Dalton's Law of Partial Pressure can be used to determine the pressure of a gas in a gas mixture. • How when a gas is collected over water the pressure of water vapor which is defined by the temperature of the water pressure must be subtracted from the total pressure to get the pressure of the gas. • How the inverse relationship between mass and velocity leads to the conclusion that the heavier a gas the more slowly it will diffuse and effuse. • How the temperature, pressure and type of gas can influence how ideal or real a gas behaves.

Assessment
During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below. Ideal Gas Law Quiz Molecular Mass and Density Quiz Partial Pressure and Gas Effusion Quiz Gases Test Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
6-10	1-5	Kinetic Molecular Theory	1

13-14, 18-21	11-12, 15-17	Properties of Gases and Measuring Pressure	2
24-25, 28-29	22-23, 26-27	Gas Laws: Boyle's Law Charles's Law	3
32, 34-35	30-31,33	Gas Laws: Avogadro's Law and Gay-Lussac's Law	4
38-40	36-37	Combined Gas Law	5
44-48	40-43	Ideal Gas Law	6
56-61	49-55	Ideal Gas Law Quiz + Gas Density and Molar Mass	7
66-70	62-65	Molecular Mass and Density Quiz +	8

		Partial Pressure	
77-83	71-76	Molecular Speeds and Effusion	9
86-88	84-85	Partial Pressure and Effusion Quiz + Ideal Gases vs. Real Gases	10
Gases Practice Problems	Gases Practice Problems	Exam Review	11
		Gases Test	12

Unit Lesson Plan – Solutions			
11 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
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.]			**New Jersey Student Learning Standard(s) – Science**
Essential Questions			
What is an electrolyte? How do we distinguish chemical and physical changes? How do we express the concentration of solutions and how can we make a solution?			

What are colligative properties and how do they affect the solution properties?

Knowledge & Skills

By the end of this unit, students will be able to:

- Identify the solvent and solute in a solution.
- Calculate molarity
- Solve stoichiometry problems involving molarity
- Calculate boiling point elevation and freezing point depression

By the end of this unit, students will know:

- How solutions form
- How solute and solvent interact
- What factors affect solubility
- How to describe concentration
- Why the properties of a solute change when a solvent is present

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Solubility & solution formation Quiz

Molarity and stoichiometry Quiz

Colligative properties Quiz

Lab – making a solution

Lab – stoichiometry and solution reactions Lab – boiling point elevation lab (or freezing point depression) Solutions Test   Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Solutions and Solubility	1
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Molarity	2
Questions from NJCTL packet	Lab	Lab – making a solution Molarity and stoichiometry	3
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and	Quiz Molarity and Stoichiometry	4

	from chemistry textbook		
	Lab	Lab - stoichiometry and solution reactions	5
	Lab	Lab - stoichiometry and solution reactions	6
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Colligative properties	7
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Colligative properties	8
	Quiz Lab	Quiz Lab – boiling point elevation	9
	Lab Review	Lab Review	10
	Test	Test - chapter	11

Unit Lesson Plan – Thermochemistry			
11 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.][Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.] **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions	
What are system and surroundings? How do we measure the heat absorbed or released in a reaction?	
Knowledge & Skills	
By the end of this unit, students will be able to: ● Calculate heat flow, specific heat ● Interpret heating and cooling curves ● Calculate enthalpy using a variety of methods ● Use a calorimeter to determine specific heat or enthalpy	By the end of this unit, students will know: ● Internal energy of a system and surroundings ● Enthalpy of a reaction ● Heating and cooling curve ● Calorimetric determination of heat exchange in a process ● Hess's law of heat summation ● Enthalpy of a reaction
Assessment	
During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below. Heat flow and calorimetry Quiz Heating curve Quiz	

Enthalpy and Hess’s law Quiz

Lab – specific heat of an unknown

Lab – enthalpy of reaction

Lab – Hess’s law

Thermochemistry chapter Test

Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Intro to energy, System and surroundings, Specific heat and heat flow calculations	1
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Calorimetry	2
Questions from NJCTL packet	Lab Questions within slides, from NJCTL packet and from chemistry textbook	Lab – specific heat Heating curves	3

Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Heating curves	4
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Enthalpy	5
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Enthalpy, Hess's law	6
Questions from NJCTL packet	Lab	Lab	7
Questions from NJCTL packet	Quiz Lab	Quiz Lab	8
	Lab Review	Lab Review	10
	Test	Test - chapter	11

Unit Lesson Plan – Thermodynamics			
6 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]	**New Jersey Student Learning Standard(s) – Science**

Essential Questions
What is entropy?

How Gibbs free energy and entropy related?

When will be a process become spontaneous?

Knowledge & Skills

By the end of this unit, students will be able to:	By the end of this unit, students will know:
● Understand the second law of thermodynamics ● Provide examples of increased or decreased entropy ● Explain how entropy contributes or detracts from a process' spontaneity ● Calculate Gibbs Free Energy ● Determine if a process is spontaneous or nonspontaneous at given conditions	● Entropy and randomness ● Entropy in change in reactions ● Calculating entropy change in reactions ● Gibbs free energy ● Free energy, temperature and spontaneity

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Entropy & 2nd Law Quiz

Gibbs Free Energy Quiz

Thermodynamics chapter Test

Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide			
Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Entropy & 2nd Law of Thermodynamics	1
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Changes of entropy in chemical and physical processes	2
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Spontaneity in relation to enthalpy and entropy	3
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Spontaneity and Gibbs Free energy	4
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook Quiz	Review Quiz	5

	Test	Test - chapter	6

Unit Lesson Plan – Acids and Bases			
5 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.[Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]			**New Jersey Student Learning Standard(s) – Science**
Essential Questions			
What is an acid? What are conjugate acid and base? What is pH?			

<table>
<tr><th colspan="2">Knowledge & Skills</th></tr>
<tr><td>By the end of this unit, students will be able to:

● Identify acids and bases using a variety of definitions
● Identify acid/base and conjugate pairs
● Describe acid/base strength
● Relate acid/base strength to pH
● Measure pH
● Calculate pH</td><td>By the end of this unit, students will know:

● Various definitions of acid and base
● Conjugate acid and base
● Measurement of pH</td></tr>
<tr><th colspan="2">Assessment</th></tr>
<tr><td colspan="2">During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Bronsted-Lowry, conjugate acid/base pairs Quiz

Acid/base strength, pH Quiz

Lab – pH and acid/base strength

Acids & Bases chapter Test

Other assessments on the NJCTL website are optional and can be used as needed.</td></tr>
<tr><th colspan="2">Pacing Guide</th></tr>
</table>

Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Definitions of acids and bases Conjugate pairs	1
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook Quiz	Review Quiz	2
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Acid/base strength pH	3
Questions from NJCTL packet	Lab	Lab - pH	4
	Test	Test - chapter	5

Unit Lesson Plan – Kinetics & Equilibrium			
8 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
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.] **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. *[Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and			**New Jersey Student Learning Standard(s) – Science**

concentrations.]	

Essential Questions

How do we measure the speed of a reaction?

What factors will affect the rate of a reaction?

What is meant by dynamic equilibrium?

How does equilibrium compromise to changes in conditions?

Knowledge & Skills

By the end of this unit, students will be able to:	By the end of this unit, students will know:
• Describe reaction rate • Understand collision theory • Explain how concentration impacts reaction rate • Interpret energy / reaction process profiles • Explain how catalysts increase reaction rate & modify the energy diagram to demonstrate the impact of a catalyst • Compare and contrast reaction rate and reaction equilibrium • Predict how a change in temperature, pressure or concentration will shift an equilibrium	• What factors determine rate of reaction • How a catalyst works • Dynamic equilibrium • The difference between rate and equilibrium position • The equilibrium constant expression • The impact of concentration, pressure & temperature at equilibrium • Le Chatelier's Principle

Assessment
During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below. Reaction rate Quiz Energy profile & catalysts Quiz Equilibrium Quiz Lab – Le Chatelier's Principle Le Chatelier's Quiz Rate and Equilibrium chapter Test Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Reaction rate, definition and factors that impact reaction rate	1

Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Energy / reaction progress profiles	2
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Catalysts	3
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Equilibrium vs. Rate	4
Questions from NJCTL packet	Questions within slides, from NJCTL packet and from chemistry textbook	Equilibrium constant Le Chatelier's Principle	5
Questions from NJCTL packet	Quiz Lab	Quiz Lab	6
Questions from NJCTL packet	Quiz Questions within slides, from NJCTL packet and from chemistry textbook	Quiz Review	7

	Test	Chapter test	8
	Questions within slides, from NJCTL packet and from chemistry textbook	Exam review	9
	Exam	Final Exam	10

Unit Lesson Plan – Organic Chemistry			
4 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
No physical science standard for this unit		**New Jersey Student Learning Standard(s) – Science**	

Essential Questions
Why is carbon so important? How are organic molecules classified? What is the role of enzymes?

Knowledge & Skills	
By the end of this unit, students will be able to: ● Explain why organic molecules involve carbon ● Draw structures for organic molecules ● Classify organic molecules ● Understand how enzymes work	By the end of this unit, students will know: ● Introduction to organic chemistry ● Carbon and its ability to form four bonds ● Classification of organic compounds: Alkanes, Alkenes and Alkynes

	• Functional groups • Amino Acids • Proteins & enzymes • Aromatic compounds • Naming organic compounds • Polymers

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Project on topic of choice

Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Classwork	Topic	Day
project	Questions within slides, from NJCTL packet and from chemistry textbook	Introduction to organic, carbon, alkanes, alkenes, alkynes	1

project	Questions within slides, from NJCTL packet and from chemistry textbook	Functional groups, drawing structures	2
project	Questions within slides, from NJCTL packet and from chemistry textbook	Amino acids, aromatic hydrocarbons, proteins, enzymes	3
project	Questions within slides, from NJCTL packet and from chemistry textbook	Polymers	4

Unit Lesson Plan – Water			
4 days	**Time Frame:**	SBOE Faculty	**Teacher:**
Secaucus High School	**School:**	10	**Grade:**
PSI Chemistry			**Subject:**
No physical science standard for this unit			**New Jersey Student Learning Standard(s) – Science**

Essential Questions
Why is carbon so important? How are organic molecules classified? What is the role of enzymes?

Knowledge & Skills	
By the end of this unit, students will be able to: ● Understand that water's special properties come from hydrogen bonding, and dipole-dipole interactions ● Understand the impact of water's high specific heat and list examples of this benefit	By the end of this unit, students will know: ● The effects of Hydrogen Bonding ● High specific heat: Moderation of temperature ● Polar solvent: role in life

• Explain why ice floats and describe the impact of this phenomenon • Describe adhesion and cohesion • Describe the acid/base properties of water	• Density of solid versus liquid form: Insulation due to Floating Ice • Adhesion and Cohesion • Acids and bases

Assessment

During the lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and in class problem solving. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

Lab activities exploring water as a solvent, heating curve, acid/base properties and/or adhesion & cohesion

Other assessments on the NJCTL website are optional and can be used as needed.

Pacing Guide

Homework**	Class work	Topic	Day
	Questions within slides, from NJCTL packet and from chemistry textbook	The effects of hydrogen bonding and high specific heat	1
	Questions within slides, from NJCTL packet and from chemistry textbook	Polar solvent, density of ice	2

	Questions within slides, from NJCTL packet and from chemistry textbook	Adhesion, cohesion, acid/base properties	3
		Various lab activities	4