ALCOSS: Chemistry.1
Differentiate among pure substances, mixtures, elements, and compounds.

Mastered:
Student will be able to master the course of study through differentiation of mixtures, elements, compounds, metals, nonmetals, and metalloids.

Present:
Student will further investigate metalloids through investigating the past present and future of semiconductors.

Going Forward:
Students will look at what semiconductors are upcoming for future usage.

Present and Going Forward Vocabulary:
Mixture, compound, element, metal, nonmetal

Career Connections:
Electrical Engineers

Advanced Understanding & Activity (Alternate activity):
Investigate any current or upcoming technology that uses semiconductors. Find out which ones have been successful. Which ones have not been successful? Explain why they were successful or not. What are some new semiconductors that are coming out soon for use? Write a paper following the rubric details to inform readers of your research.

Writing rubric in Appendix B

Literature Connections/Resources:
- Wikipedia- http://en.wikipedia.org/wiki/Semiconductor
- How Stuff Works- http://electronics.howstuffworks.com/diode.htm

ALCOSS: Chemistry.2
Describe the structure of carbon chains, branched chains, and rings.

Mastered:
Students can describe the structure of carbon chains, branched chains, and rings.

Present:
Students will read an article about nanotubes and nanowires in the *Chem Matters* publication.

Going Forward:
Students will reflect on the positive and negative effects of the usage of nanotubes and buckyball fullerenes.

Present and Going Forward Vocabulary:
Buckyball, fullerenes, nanotechnology

Career Connections:
Molecular Manufacturer, Chemical Engineer, Pharmaceutical Engineer, Chemist, Telecommunications Engineer, Military Defense Engineer

Advanced Understanding & Activity (Alternate activity):
Choose one or more of the following activities to complete as alternate activities to the general assignments.

1. **That's Good! That's Bad! Chain story** (Student page found in Appendix A)
   Students will research the following questions regarding nanotechnology (see literature connections).
   - What are the positives and negatives of nanotechnology?
   - What can go wrong when using nanotechnology?

   Then students will read the That's Good! That's Bad! scenario. Students will write and illustrate the chain of events to show the positive and negative situations surrounding the scenario. You may use additional sheets of paper in order to complete your story.

   Scenario:
   The high school seniors planned to go to Orange Beach for Spring Break. On the first Saturday of Spring break, everyone met at the high school parking lot. They loaded everything into the

van and headed south on Highway 65. Sally was bored and began reading the label of the suntan lotion. "STOP THE VAN!" cried Sally. The driver pulled the van over and turned around to see her.

"What's wrong?"

"This lotion has nanotechnology. I don't want little robot bugs crawling on me! Oh, that's bad!"

2. **Students will construct their own buckyball model by using the buckyball instructions sheet.** Instructions may be obtained at one of the following Web sites. Review each Web site to determine your preferred type of "building" materials.

   - Ozpod.com- http://www.ozpod.com/zome/buckyball.pdf
   - YouTube- http://www.youtube.com/watch?v=e-BZGxwycUQ
   - National Museum of American History- http:// invention.smithsonian.org/centerpieces/ilives/kroto/buckyball.pdf
   - SEED: Schlumberger Excellence in Educational Development- https://www.planetseed.com/node/19769

Literature Connections/Resources:

- *Chem Matters* "Reading Nanotechnology" pages 7-9 located at http://portal.acs.org/portal/PublicWebSite/education/resources/highschool/chemmatters/archive/CNBP_023539
- Wikipedia- http://en.wikipedia.org/wiki/Nanotechnology

ALCOSS: Chemistry.3

Use the periodic table to identify periodic trends, including atomic radii, ionization energy, electronegativity, and energy levels.

Mastered:

Students can use the periodic table to identify periodic trends, including atomic radii, ionization energy, electronegativity, and energy levels.

Present:

Students will further their understanding of periodic trends through creating a picture book of the Periodicity Book of Trends that is on an elementary level.

Going Forward:

Students will use their product to explain the trend of a new element yet to be discovered or students will use their booklet to explain the trends to another student.

Present and Going Forward Vocabulary:

Electronegativity, atomic radius, ionization energy

Career Connections:

Chemist, Molecular Engineer, Chemical Engineer

Advanced Understanding & Activity (Alternate activity):

Periodicity Book of Trends

Students will research the answers to the statements below. Remember to cite properly any direct quotes, including Internet Web sites. Create a children's picture book on the Periodicity Book of Trends using a software program like Publisher or Word, or using hand-made pop-up techniques. Make it colorful, appealing to the uninformed reader, and informative. It should address all the points below. Your text book(s) are good jumping off points for these bullets.

1. The Periodic Table

- Describe the arrangement of elements in the periodic table in order of increasing atomic number.
- Distinguish between the terms, groups, and periods.

2. Physical Properties

- Define the terms first ionization, energy, and electronegativity.
- Describe and explain the periodic trends in atomic radii, ionic radii, first ionization energies, electronegativities and melting points for the alkali metals (Li → Cs), halogens (F → I).
- Explanations for the first four trends should be given in terms of the balance between the

attraction of the nucleus for the electrons and the repulsion between electrons. Explanations based on effective nuclear charge are not required.
- Describe and explain the periodic trends in atomic radii, ionic radii, first ionization energies, electronegativities for elements across the third period.

3. Chemical Properties
- Discuss the similarities in chemical nature of elements in the same group.
- The following reactions should be covered:
  - Alkali metals (Li, Na and K) with water
- Alkali metals (Li, Na and K) with halogens (Cl_2, Br_2 and I_2)
- Halogens (Cl_2, Br_2 and I_2) with halide ions (Cl^-, Br^- and I^-)

4. Trends across Period 3
- Explain the physical states (under standard conditions) of the chlorides and oxides of the elements in period 3 in terms of their bonding and structure.
  - Include the following oxides and chlorides:
  - Oxides: Na_2O, MgO, Al_2O_3, SiO_2, P_4O_6 and P_4O_{10}, SO_2 and SO_3, Cl_2O and Cl_2O_7.
  - Chlorides: NaCl, $MgCl_2$, Al_2Cl_6, $SiCl_4$, PCl_3 and PCl_5 and Cl_2.
  - Describe the reactions of chlorine and the chlorides referred to in 13.1.1 with water.

5. First-row d-block elements
- List the characteristic properties of transition elements.
  Examples should include variable oxidation number, complex ion formation, existence of colored compounds and catalytic properties.
- Explain why Sc and Zn are not considered to be transition elements.
- Explain the existence of variable oxidation number in ions of transition elements.
  - Transition elements can show an oxidation number of +2. In addition, be familiar with the oxidation numbers of other elements that have variable states such as Cr (+3, +6).

It is OKAY to have a little fun with this. Make it colorful and simple but yet informative.

Literature Connections/Resources:
- Periodic Table with Absorption and Emission: http://jersey.uoregon.edu/vlab/elements/Elements.html
- Dynamic Periodic Table: http://ptable.com/
- WebElements: http://www.webelements.com/
- GPB Television-Organization of the Periodic Table: http://www.gpb.org/chemistry-physics/chemistry/402

ALCOSS: Chemistry.4
Describe solubility in terms of energy changes associated with the solution process.

Mastered:	**Present:**	**Going Forward:**
Students can describe solubility in terms of energy changes associated with the solution process.	Students will use a simulation Web site to use their knowledge of pH and acquired knowledge of pH to determine a substance.	Students will have a deeper knowledge of titrations and pH through experimentation using the simulation Web site.

Present and Going Forward Vocabulary:
Henderson-Hasselbalch, log scales

Career Connections:
Medical Technologist, Chemist, Chemical Engineer, Pharmaceutical Engineer, Laboratory Scientist, Research Nutritionist

Advanced Understanding & Activity (Alternate activity):
Simple Dilution Simulation (Student sheet in Appendix A)
Students will use the Interactive Simulations Web site hosted by the University of Colorado at Boulder, to explore simple dilutions. Go to the following Web link http://phet.colorado.edu/en/simulation/ph-scale.

At the Web site, click the green button **Run Now!** It will take a few minutes for the online simulation program to open. As you conduct your online investigations, answer the following questions.

- There are many household items for which we can find the pH and change that pH by adding water. What is this process called?
- Using milk first, add some water (the amount is your choice) to set up the information needed to find a new pH.
- The pH is given to you in the online chart, but can you use the numbers to calculate the molarity using the Henderson-Hasselbalch equation?
- Make sure you write down all the pertinent information in the chart below. Play around with it first to get the hang of it!
- Do this for ten different combinations. Have fun with it!
- Where might you have done a similar experiment in your kitchen?
- Did you know you were changing the solutions acidity? Why or why not?

Complete this chart as you conduct the online investigations (sample chart below)

Substance used	Starting pH	Amounts of Starting Substance (L)	Amount of Water Added (L)	New pH	New Concentration M (mols/L)
Example: Milk	6.5	1L	0.20L	6.55	$2.8x10^{-7}$ M

Literature Connections/Resources:

- Acids, Bases, and the Henderson-Hasselbalch Equation: http://www.lsbu.ac.uk/biology/biolchem/acids.html
- Wikipedia-Henderson-Hasselbalch: http://en.wikipedia.org/wiki/Henderson%E2%80%93Hasselbalch_equation

ALCOSS: Chemistry.5

Use the kinetic theory to explain states of matter, phase changes, solubility, and chemical reactions.

Mastered:

Students can use the kinetic theory to explain states of matter, phase changes, solubility, and chemical reactions.

Present:

Students will use their prior knowledge about Kinetic Molecular Theory (KMT) to do an activity and think about the effects on a fictitious planet.

Going Forward:

Students will acquire a better understanding of KMT and gasses through the activity.

Present and Going Forward Vocabulary:

Standard Temperature and Pressure (STP), atmosphere

Career Connections:

Chemist, Physicist, Engineer

Advanced Understanding & Activity (Alternate activity):

Planet Alabama High School*

From a very young age we understand that most life cannot exist without the atmosphere or air. However, very few ponder the other common objects or tasks which would be impacted by a lack of an atmosphere. Listed below are a number of objects. Assess what impact, if any, a complete lack of atmosphere would have on each one. We will assume, for the sake of argument, that you are able to function in this "atmosphere-less" environment–that means you cannot use, "Well I'd be dead. So nothing would work!," as an excuse.

- Choose ten completely different items from the list. (iPod and cell phone are similar).
- Work independently through the list, jotting down your individual thoughts and ideas.
- After about ten minutes, you may get together in groups of no more than three students. Collectively, you need to back through the list.
- For every item you must provide:
  A. WHAT EFFECT, if any, will a lack of atmosphere have on the object's normal function?
  B. WHY will it be affected?
  C. Is there a gas law that could be applied to understand?
  D. Would there be an alternate item that could be used in its place on Planet Alabama?

1. Suction cup	2. Model Rocket	3. Aerosol spray can
4. Candle	5. Baseball and bat	6. Plant
7. Match	8. Syringe	9. Parachute
10. Flashlight	11. Pogo stick	12. Automobile
13. Vacuum cleaner	14. Clothes dryer	15. Swing
16. Helicopter	17. Air bag (from a car)	18. Balloon
19. Paint	20. iPod	21. Frisbee
22. Computer	23. Light stick (chemical glow stick)	24. Smoke detector
25. Drinking straw	26. Football	27. Broom
28. Bicycle pump	29. Shotgun	30. Alarm clock
31. Bow and arrow	32. Flag	33. Golf ball
34. Squirt gun	35. Magnet	36. Internet
37. Refrigerator	38. Cell Phone	

Can you think of other things either around your room, house, or classroom that would be impacted by life without atmosphere? List at least five items.

*Adapted from handout from a session at the National Science Teachers Association (NSTA) in Birmingham, AL, 2007. Author unknown.

Literature Connections/Resources:
- Kinectic Molecular Theory: Basic Concepts: http://www.chm.davidson.edu/vce/kineticmoleculartheory/basicconcepts.html
- Kinectic-Molecular Theory: http://itl.chem.ufl.edu/2041_u00/lectures/lec_d.html

ALCOSS: Chemistry.6
Solve stoichiometric problems involving relationships among the number of particles, moles, masses of reactants and products in a chemical reaction.

Mastered:
Students can solve stoichiometric problems involving relationships among the number of particles, moles, masses of reactants and products in a chemical reaction.

Present:
Students will write a math story and create a flowchart for stoichiometry as well as find percent yield and percent error.

Going Forward:
Students will predict products in laboratories and produce experiments with low percent errors.

Present and Going Forward Vocabulary:
Percent yield, percent error

Career Connections:
Chemist, Geochemist

Advanced Understanding & Activity (Alternate activity):

Stoichiometry Math Story (Student page found in Appendix A)

Write a Stoichiometry word problem about a day you could have in the laboratory using the materials listed. What would be produced? What would be the limited reactants? What would be the percent error and percent yield? Write your word problem (including your answer), then write a short story using your word problem in the space below. You may use the back of this sheet and/or additional sheets of paper. Make a flow chart to show the steps of the problem.

Materials:

0.5 grams Copper Chloride
0.5 grams Aluminum
Actual solid product produced 0.22 grams

Literature Connections/Resources:

- GPB Television-Mass/Mass Stoichiometry Problems and Percent Yield http://www.gpb.org/chemistry-physics/chemistry/802
- Wikipedia: http://en.wikipedia.org/wiki/Stoichiometry

ALCOSS: Chemistry.7

Explain behavior of ideal gases in terms of pressure, volume, temperature, and number of particles using Charles's Law, Boyle's Law, Gay-Lussac's Law, the Combined Gas Law, and the Ideal Gas Law.

Mastered:

Students can explain behavior of ideal gases in terms of pressure, volume, temperature, and number of particles using Charles's Law, Boyle's Law, Gay-Lussac's Law, the Combined Gas Law, and the Ideal Gas Law.

Present:

Students will use a RAFT activity to select a topic that is built around a gas law concept. Students will decide what gas law to apply.

Going Forward:

Students will acquire a deeper understanding of Gas Laws and understand where they are applicable in real world situations.

Present and Going Forward Vocabulary:

Inversely proportional, Standard Temperature and Pressure (STP)

Career Connections:
Chemist, Chemical Engineer, Meteorologist, Laboratory Scientist, Manufacturer Engineer

Advanced Understanding & Activity (Alternate activity):

RAFT (Student page found in Appendix A)

Students will choose one row. They will write about the TOPIC from the perspective of the ROLE to the AUDIENCE using the FORMAT. You can allow students to choose one item from each of the four columns. Provide an audience for the student to present their product. Students may need to plan their product using the organizational tool, Project Planner.

ROLE	AUDIENCE	FORMAT	TOPIC
Meteorologist	Car Owners	TV Commercial	Car Tires
Clown at a birthday party	5 year olds	Skit	Balloons
Movie Theater Owner	Movie Goers	Rap	Popcorn Kernels

Literature Connections/Resources:

- Gas Laws: http://www.scienceclarified.com/everyday/Real-Life-Physics-Vol-2/Gas-Laws.html

ALCOSS: Chemistry.8

Distinguish among endothermic and exothermic physical and chemical changes.

Mastered:

Students can distinguish among endothermic and exothermic physical and chemical changes.

Present:

Students will brainstorm about endothermic and exothermic reactions by designing and performing a laboratory experiment on M&M's solubility.

Going Forward:

Students will understand endothermic and exothermic reactions and physical and chemical changes.

Present and Going Forward Vocabulary:

Adaptations

Career Connections:

Laboratory Scientist, Medical Technologist, Manufacturer Engineer, Endocrinologist, Nutritionist, Chemical Engineer

Advanced Understanding & Activity (Alternate activity):

Students will design a laboratory experiment using M&M's and warm/hot water. Students will learn that the color moves faster in hot water than in room-temperature water and much faster in hot water than in cold water. Students will control the independent variables and graph their findings.

M&M's Solubility

The Mars Company claims M&M's melt in your mouth not in your hand-but how can this be? Why do they not melt in your hand?

Your task is to design a lab using M&M's and test exactly at what temperature they melt in hot water. Follow the scientific method, keeping in mind the independent variables.

Safety precaution! Be sure to be careful when using hot water. Remember your lab safety rules.

- Does color or the type of candy matter?
- Do at least three tests of your design to ensure reliability and validity.

Make a graph of your findings and write a summary of what you have found.

Be sure to explain why the temperature of water matters to the findings.

- How would your findings differ in a 10%, 20% and 30% sucrose solution?
- What kind of changes are taking place in the candy? Explain.
- Do you think your procedure would work for Skittles? Why or why not? What could be different? What would be alike?

Literature Connections/Resources:

- Wikipedia: Endothermic- http://en.wikipedia.org/wiki/Endothermic
- Wikipedia: Exothermic http://en.wikipedia.org/wiki/Exothermic

ALCOSS: Chemistry.9
Distinguish between chemical and nuclear reactions.

Mastered:
Students can distinguish between chemical and nuclear reactions.

Present:
Students will investigate the nuclear disaster that occurred in Chernobyl, Ukraine, and Fukishima, Japan. Students will also explore where there could be a potential nuclear accident in Alabama.

Going Forward:
Students will acquire an understanding of what could occur if there was a nuclear meltdown. Students will reflect upon the idea of increasing nuclear power in the United States.

Present and Going Forward Vocabulary:
Alpha particle, beta particle, position

Career Connections:
Nuclear Physicist, Nuclear Chemist, Radiologist, Oncologist, Hematologist, Pathologist, Scientific Photographer, Climatologist, Nuclear Engineer, Statistician

Advanced Understanding & Activity (Alternate activity):

It's Nuclear!

Students will compare the nuclear disasters in Chernobyl, Ukraine to Fukushima, Japan. Then students will research the potential disasters in Alabama. After researching each item, students will write a seven paragraph paper with the following information and a Nuclear Disaster Evacuation Manual.

- **Paragraph one:** Introduction to the topic of nuclear disasters.
- **Paragraphs two-three:** Students will visit the website http://www.kiddofspeed.com. Students will observe the pictures that were taken during the trip to Chernobyl. Students will write two paragraphs on their observations of how the residents of Chernobyl must have felt having to leave their town, including the details of what was left behind.
- **Paragraphs four-five:** Students will visit the Web site http://www.iaea.org/newscenter/news/tsunamiupdate01.html. Students will write two paragraphs on their observations of how the residents of Fukushima must have felt not being able to return to their homes after the tsunami, including the details of what was left behind.
- **Paragraph six:** Students will visit the website http://www.eia.doe.gov/cneaf/nuclear/state_profiles/alabama/al.html. This web site will list the nuclear plants in Alabama. In the sixth paragraph, students will explain the risks that Alabamians may have to being exposed to a nuclear disaster like Chernobyl and Fukushima.
- **Paragraph seven:** Summarize the research from Chernobyl to Fukushima to Alabama.

After completing the paper, students will develop a Nuclear Disaster Evacuation Manual for their community. Include the route, instructions to community members for immediate evacuation, and determine what would be the most important thing for you, the student, to take if there was a nuclear evacuation.

Literature Connections/Resources:
- Wikipedia-Nuclear Energy: http://en.wikipedia.org/wiki/Nuclear_energy
- Wikipedia-Nuclear Power: http://en.wikipedia.org/wiki/Nuclear_power