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August 2008

Chem. 508 Lesson plan

Target students: 11th grade, general chem.
Level: Honor
Topic: "Clean Air" types of chemical reactions
Time: 3-class meetings (84 minutes each)
Location: Brandywine High School, Wilmington, DE
Instructor: Nader Makarious

National Science Content Standards	**Chemistry EU**
UCP.3, UCP.5; A.1; B.2, B.3, B.6 UCP.3, UCP.5; A.1; B.2, B.3 UCP.3, UCP.5; A.1, A.2; B.2, B.3, B.6	• Chemistry is an experimental science where bridges are built between experimental observations and underlying concepts. • Learning science through courses taught using research-based teaching practices would provide teacher-participants with first-hand experiences in the effectiveness of, and problems with, such practices.

Delaware Department of Education Standards for Science/ GLE	**Objective**
• Students should be able to design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. **(1.1.2) 11.1.b** • Students should be able to collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results. **(1.1.3) 11.1.c** • Students should be able to conduct experiments and provide evidence (e.g., formation of a precipitate, evolution of gas, change of color, release/absorption of energy in the form of heat, light, or sound) to determine if a chemical reaction has occurred. **(1.1.2) (1.1.3) (2.4.1) 11.2.q** • Students should be able to describe chemical	Students should be able to conduct online scientific research, collect data, search scientific journals, create accepted proposal and write a scientific report Students should be able to conduct a lab activity, record data, organize lab report, and follow safety protocol Students will work in small groups, report to the whole class, discuss and share ideas Recognize evidence of chemical change (changing in color, evolving of gas, formation of precipitates, changing in kinetic energy Observe evidence and record data Students will work on POGIL activity and write

reactions using correct chemical formulae and balance the resulting chemical equation. **(2.4.1) (2.4.2) 11.2.s** • Students should be able to classify various reactions as synthesis (combination), single replacement, double replacement, decomposition or combustion. **(2.4.2) 11.2.t** • Students should be able to explain whether or not a chemical reaction would occur given a set of reactants. Students should be able to predict the product(s) if the reactions would occur. **(2.4.2) 11.2.u**	balanced chemical equation Represent chemical reaction with equations Classify chemical reactions Identify the characteristics of different classes of chemical reactions Describe aqueous solutions Predict of chemical reaction would occur or not according to the metal activity
Vocabulary synthesis reaction, combustion reaction decomposition reaction, single-replacement reaction, double-replacement reaction, precipitate, activity series. ground level ozone, stratosphere, troposphere.	

Students' background knowledge
Students have studied naming and writing chemical formula, ionic compounds, covalent compound, oxidation number, writing balancing chemical equation, lab safety protocol, writing lab report, and working in group using POGIL activities.

Assessment Evidences

Portfolio Assessment Project report on alternative fuels which do not contribute to the ground level Ozone pollution in Wilmington, DE	**Knowledge Assessment** Written quiz at the end of the unit POGIL written part Clean air project report Lab report
Performance Assessment Lab work and lab report, lab rubric will be used to assess students' work (self evaluation/instructor evaluation) Use of complete balanced chemical equations Use the correct chemical formulas and physical stats for each reactant and product Provide clear evidence for each type of chemical reaction	**Skill Assessment** POGIL activity, work in groups, report back to the whole class Follow lab safety protocol

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Lesson Plan

"Air Quality in Wilmington, DE"
Types of Chemical reaction

Day one

Purpose: to introduce students to a real-life problem in their hometown. Students need to use scientific method to investigate the problem, collect data, organize reports, and then create a proposal to solve this problem.
Students will be given the plan for the whole week work, also this plan will be posted o the blackboard

Materials:

Videotape, clean air case study booklet, project outlines handout.

Introduction:

Videotape (**20 minutes**) about ground level ozone, a case study made by the state of California, follows up with a discussion about the following questions (**15 minutes**)

1- What is Ozone?
2- What is Ozone layer? And where does it located?
3- What is the importance of the Ozone layer?
4- What is ground level Ozone?
5- Why Ozone is really important and beneficial in the stratosphere, and harmful in the troposphere?
6- What is the main reason behind the ground level ozone pollution in Wilmington, DE? (Hint: Ozone pollution exists only in north DE not in the south?

Demonstration: (**5 minutes**)

Ozone recipe: How NOx and VOC (volatile organic compounds) generate ground level Ozone.
Complete and balance chemical equation will be used in this part on the blackboard

Group discussion (20 minutes)
Students will work in small groups (groups of 4), clean air booklets will be provided (if they need to use them). The product of this discussion is a primary proposal to solve the ground level ozone problem in Wilmington DE.
Rules

- Even though students are working in groups but each one has to keep a record of their group's data
- Each group has to report in 20 minutes to the whole class.
- Report in form of bullets big poster/ markers.
- Each group should designate one to report, record, time manager, and a discussion leader.

Formative assessment

Groups reports and discussion: (**15 minutes**)

- Each group will report to the class providing their proposal. Posters will be hanged up around the room; groups will move around (poster tour) and take notes.
- After students go back to their seats, we will have a closing discussion about their proposals, and clean air project outlines will be handed out

Reflection and Homework

Students will start a primary search on renewable fuels that may help to reduce the ground level Ozone pollution. Talk about at least three different alternative fuels (a paragraph each), or only one type of fuel (3 paragraphs), all work have to be cited.

Day Two: POGIL

Introduction (10 minutes)

- Period will start with brief discussion about alternative fuels search, and if any available locally.
- Students will be guided to move a further step and start to search alternative fuel of interest in depth. Main purpose of this second search is to find out about the chemical reactions of this fuel, and how it made.

High School Drama POGIL

Guided Practice

- Students will work in groups of four (same group), students have to record their data individually, and help will be provided if needed.

Model one (15 minutes)

- Students will study model one, answer questions 1-5, and do exercise 1

Differentiation:

- Some students may need help for exercise 1; these 15 minutes provide the instructor with time for some individual guided help.

Formative assessment 1
Class report and discussion: **(15 minutes)**

- A student from each group will write a balanced chemical equation on the blackboard (exercise 1, five equations)
- Discuss the key for each type of chemical reaction (how to identify it)
- Students will provide examples of each type of chemical reaction in our life, and try to link this example if possible to the clean air project.

Model two (20 minutes)

- Students will keep working in the same groups.
- Read the story in model two, answer questions 1-7, and then answer questions 1-5 in exercise 2.

Formative assessment 2
Class report and discussion **(15 minutes)**

- All class will share the story of Paige, Leah, Collin, and Eric. Use the analogy to classify the different types of chemical reactions.
- Five students (different from those reported in exercise one) will report to the blackboard, write the chemical equations and classify the type of chemical reaction.

Reflection and Homework

- Students will share their ideas about which type of chemical reaction relates directly to the air pollution problem.
- Students need to think of at least two different chemical reactions for their project report.
- Lab handouts will be available; formal pre-lab is required for next day work as well as appropriate clothes.
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Day Three: Lab

Introduction: pre-lab discussion (**10 minutes**)

- Instructor will disuses lab procedure, including safety precaution.

Lab work **(60 minutes)**

- Students will work in pairs, conduct lab, follow safety protocol, take accurate observations, collect and record data in lab notebook.
- Students have to clean their station when they finish working. Back to their seat, and finish analysis and conclusion questions (see Lab handout)

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Reflection: Post Lab discussion (**10 minutes**)

- What type of chemical reaction was observed in each step?
- What is the evidence for your conclusion?
- Would any reaction fall under two different categories of types of chemical reactions? If Yes, which one? What's your reasoning?

- A plan for next day will be provided which will include
    1. Instructor presentation about Biodiesel fuel as an alternative for fossil diesel (thesis work)
    2. More details for clean air project (due date a week from today)
    3. A 15 minutes quiz on types of chemical reaction

Homework.

- Students should finish lab report for homework
- Students should use lab rubric to evaluate their work (see lab rubric attachment)

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POGIL

"High School Drama"

Bookstores, supermarket, and music stores are among many places where thing are classified and organized. Chemists classify chemical reactions in order to organize the numerous numbers of reactions that occur daily in living things and in laboratories.
Knowing the main categories of chemical reactions can help you to remember and understand them. It also helps you to recognize pattern and predict the products of many chemical reactions.

Model 1: Types of Chemical Reactions

Type of Reaction	Symbols	Chemical Equations
Synthesis	A+B → AB	$2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
Decomposition	AB → A+B	$2NaN_3 \rightarrow 2\ Na + 3\ N2$
Single Replacement	A+ XY → AY + X	$2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
Double Replacement	AB+ XY → AY+ XB	$2\ NaBr + Ca(OH)_2 \rightarrow CaBr_2 + 2\ NaOH$
Combustion	$A + O_2$ → AO_x	$C_{10}H_8 + 12\ O_2 \rightarrow 10\ CO_2 + 4\ H_2O$

Questions:

1- What is the key to identify a single replacement reaction?

2- How can you relate Synthesis reaction to the Decomposition reaction?

3- What does (x) represent in the Combustion reaction?

4- Is combustion reaction endothermic or exothermic?

5- Use a complete sentence to describe the Double Replacement reaction.

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Exercise 1

Predict products and write complete balanced chemical equations for the following reactions:

1. Lead (II) nitrate reacts with potassium chromate (chromate ion = CrO_4^{-2})

2. Combustion of isopropyl alcohol, C_3H_7OH

3. Hydrochloric acid (HCl) reacts with metal magnesium

4. Chlorine gas reacts with sodium metal

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Model 2: High School Drama

Paige and Leah always like to chat during the chemistry class; the main daily topic is boyfriend/ girlfriend relationships. Paige is dating Collin, and Leah is dating Eric. Both of Paige and Leah keep fight and break up with Collin and Eric, and then go back to each other, a week up and a week down. Lately a big fight started between Paige and Leah after Leah found out that Paige went out with Eric to watch a movie. Now Paige is more interested to see Eric not Collin. Moreover, Leah started to go out with Collin. A month later, Paige is dating Eric, and Leah is dating Collin, no surprise, we are in high school.

Answer the following question:

1- Which arrow will you use (→) or (↔) to represent the relationship between either Paige and Collin, or Leah and Eric? Explain?

2- Represent a happy week of Paige and Collin as a chemical equation? What type of chemical reaction this equation represents?

3- Represent a bad week for Leah and Eric (when they break up) as a chemical equation? What type of chemical reaction this equation represents?

4- Represent what happened when Paige went out with Eric instead of Collin as a chemical equation? What type of chemical reaction this equation represents?

5- Put the old relationships between Paige, Leah, Collin, and Eric, and the new one in a chemical equation? What type of chemical reaction these equations represent?

6- In your opinion, why did Paige start to date Eric instead of Collin?

7- Finally which chemical reaction precisely represents Mr. Makarious who has to deal with this drama everyday in his room? (Hint: in model one, either second or last reaction)

Exercise 2

Identify the type of chemical reaction shown in the following equations:

1) $CaO(s) + H_2O\ (l) \rightarrow Ca\ (OH)_2\ (s)$

2) $2Al(s) + 3CuCl_2\ (aq) \rightarrow 2AlCl_3\ (aq) + 3Cu(s)$

3) $AgNO_3\ (aq) + NaCl\ (aq) \rightarrow AgCl(s) + NaNO_3\ (aq)$

4) $2C_2H_6\ (g) + 7O_2\ (g) \rightarrow 6H_2O\ (g) + 4CO_2\ (g)$

5) $2\ NaCO_3\ (s) \rightarrow 2Na\ (s) + O_2\ (g) + 2\ CO_2\ (g)$

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Lab Types of Chemical Reactions

Background:

There are many different types of chemical reactions. Most reactions used in an introductory chemistry course can be classified into five major categories: synthesis, decomposition, single replacement, double replacement, or combustion. This lab will give you the opportunity to observe chemical reactions from four of these major categories.

Materials:

Bunsen Burner	Wood Splints
Crucible Tongs	Evaporating Dish
Micro- spatula	Test Tube Holder
4 Large Test Tubes	4 Small Test Tubes
Test Tube Rack	Sandpaper
Utility Clamp	Ring Stand

Chemicals:

Mossy Zinc	1M Copper (II) Sulfate
Copper Wire	0.1M Zinc Acetate
Magnesium Ribbon	0.1M Sodium Phosphate
Copper (II) Carbonate	6M Hydrochloric Acid
Sodium Bicarbonate	Potassium Chlorate

Procedure:

Note: For each of the procedures, you should record observations of starting and ending materials in addition to any reactions that take place.

1. Add 5 mL of 1M copper (II) sulfate solution to a small test tube. Place a few pieces of mossy zinc in the solution. This reaction will take a while to occur – move on before noting final observations.
2. Obtain a piece of shiny copper wire. Use fine sandpaper if needed to clean the wire until it is shiny. Using crucible tongs, hold the ribbon in the burner flame for 1-2 minutes.
3. Place 2 micro-spatulas of copper (II) carbonate in a large test tube. Using a test tube holder, heat the tube for about 3 minutes. Insert a burning wood splint into the test tube.
4. Add 2 mL of 0.1M zinc acetate to 2 mL of 0.1M sodium phosphate solution in a small test tube.
5. Place an evaporating dish near the base of a burner. Using crucible tongs, hold a sample of magnesium ribbon in the burner flame until it starts to burn. Quickly move the sample over the evaporating dish.

CAUTION: DO NOT LOOK DIRECTLY AT THE FLAME. HOLD THE BURNING MAGNESIUM DIRECTLY OVER THE EVAPORATING DISH. When the ribbon stops burning, put the remains in the evaporating dish.

6. Place one micro-spatula of sodium bicarbonate in a test tube. Add 10 drops of 6M hydrochloric acid.
7. Stand a large test tube in the test tube rack. Add 5 mL of 6M hydrochloric acid to the tube. Carefully drop a piece of mossy zinc into the acid. Using a test tube holder, invert a second large test tube over the mouth of the reaction test tube. Remove the inverted tube after about 30 seconds and quickly insert a burning wood splint into the mouth of the inverted tube to test the gas that was generated in the reaction.
8. Clamp a large test tube above a burner. Place two micro-spatulas of potassium chlorate into the tube. Heat the substance until it turns to a liquid. Once the substance begins bubbling, place a glowing wood splint in the test tube.

Analysis:

1. Write complete balanced equations for each reaction. Write the names of the products below the equation. Classify each reaction as a synthesis, decomposition, single replacement, or double replacement reaction.
2. For each reaction, list the convincing and circumstantial evidence that proved a chemical reaction had taken place in each procedure.
3. Write the equation for the reaction that occurred in testing the gas that was evolved in step 7. Classify this reaction as a synthesis, decomposition, single replacement, or double replacement reaction.

Conclusions:

1. Compare and contrast the four types of reactions observed in this investigation.
2. Write a generalization statement for each of the four classes of reactions based on your results.

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Brandywine High School Scoring Rubric for Investigative Labs

Experiment #: ____ Title: _____ Name: _____

Rating	I: Testable Hypothesis	II: Procedure	III: Data	IV: Calculations
Excellent 4	• Hypothesis is a clear and concise statement • Hypothesis is directly related to the problem • Hypothesis is testable • Hypothesis is in "If…then…" format	• All critical steps included • Procedure contains enough detail to be replicated by another • Procedure is clear and concise; does not sacrifice important details	• All quantitative data has correct units • Data are clearly and logically organized (e.g. data table) • Data are recorded to the appropriate precision for the device used (i.e. attention is paid to significant figures) • Appropriate detail is present in qualitative observations	• Correct formulas are used • All work is performed correctly and shown for calculations • Correct units are present
Acceptable 3	• Hypothesis is clear but wordy, or concise but vague • Hypothesis does relate to the problem • Hypothesis is testable • Hypothesis is worded to include an if or a then statement, but not both	• Most of the critical steps are included. • Procedure contains most of the details needed to be replicated by another • Procedure is mostly clear and concise. Most important details are present	• Most quantitative data has correct units. • Data are organized logically. • Few or no errors in recorded data. • Most details for qualitative observations are sufficient.	• Most formulas are correct • Most of the work is performed correctly and shown for calculations • Correct units are present
*Needs Some Improvement 2	• Hypothesis is incomplete or vague and wordy • Hypothesis may relate to a problem • Hypothesis is not testable • Hypothesis is worded to indicate a variable being tested	• Some critical steps are missing. • Procedure is missing some of the detail needed to replicate • Some of the procedure is unclear and/or wordy.	• Some errors in qualitative data are apparent. • Some pieces of data are recorded in an unclear manner. • Details for qualitative observations are missing some details or are irrelevant.	• Very few formulas are used correctly • Very little work is performed correctly and shown for calculations • Very few units are present
*Requires Significant Improvement 1	• Hypothesis is missing or does not relate to the problem. • Hypothesis is not testable • Hypothesis does not indicate the variable being tested	• Most critical steps are missing • Procedure lacks sufficient detail to be replicated • Most of the procedure is unclear and wordy; important details are missing	• Units missing from quantitaive data • Data are unclear, not logically organized or illegible • Data are recorded with little or no precision • Qualitative observations are missing or without detail	• Incorrect formulas are applied or formulas are absent • Work is not present or is grossly incorrect • Units are absent or incorrect
Self-Assessment				
Instructor Assessment				

*Students scoring in this range for a domain are strongly encouraged to schedule a conference with the instructor.
Note: Labs submitted without self-assessments will not be accepted.

Scores for assigned questions

1	2	3	4	5	6
/	/	/	/	/	/

Final Score:

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Rating	V: Analysis and Evaluation of Error	VI: Conclusion, Discussion and Recommendations	VII: Lab Protocols	VIII: Grammar, Mechanics and Form
Excellent 4	• Appropriate type of graph is used • All DSTP criteria are met • Results are complete and clearly stated • Appropriate discussion of discrepancies(errors) is present	• Complete explanation of hypotheses or objectives. • Terminology is appropriate • Effective evaluation and in-depth analysis of the concepts covered in lab • Discussion is clearly connected to other content • Recommendation for future study and improvement	• All equipment was used correctly and appropriate for the task • The students worked effectively as a group and shared responsibilities equally • There were no safety infractions	• No mistakes in spelling, grammar or punctuation • Responses are legible and in complete sentences • Submitted work is clean and in good condition • Lab components are in the correct sequence
Acceptable 3	• Graph used was correct type and correctly graphed. However, 1 label is missing or a label is incomplete (ex. title, x-axis, y-axis). • Most of the DSTP criteria are met. • Most of the results are included and stated clearly. • Most if not all discrepancies are stated but not discussed in detail.	• Explanation of hypotheses adequate, mostly correct. • Some terminology used correctly, but limited in scope. • Evaluation, analysis, and connections satisfactory. • Connections to purpose/objectives are present, but not complete. • Recommendations satisfactory, but limited in application for improvement.	• Some equipment used was inappropriate for the task • The group worked effectively, but more work was placed on one individual. • There were no safety infractions	• There are few mistakes in spelling, grammar or punctuation • Most responses are legible and in complete sentences • Submitted work is clean and in good condition • Lab components are in the correct sequence
*Needs Improvement 2	• Graph is correct type and coordinates placed correctly, but 2 or more labels are missing or incorrect. • Meets some of the DSTP criteria. • A few of the most obvious results are included but are not written clearly enough to sufficiently support the conclusion. • Discrepancies are mentioned but not discussed.	• Explanation of hypotheses there, but incomplete or has gaps. • Some terminology used correctly, but not scientifically. • Evaluation, analysis, and connections present but limited or partially correct. • Connections to purpose/objectives are unclear. • Recommendations minimal and/or vague as to use for improvement.	• Some equipment was damaged • A student was ineffective as a member of a group; significantly more responsibility was placed on one individual than the other • There were no safety infractions	• There are many mistakes in spelling, grammar or punctuation • Responses are barely legible or some are incomplete sentences • Submitted work slightly tattered, wrinkled and / or has torn or ragged edges • One or two lab components are in the wrong sequence
*Requires Significant Improvement 1	• Graph used is inappropriate for the data or is absent • None or few DSTP criteria are met • Results are absent • No discrepancies are mentioned or discussed	• Explanation of hypothesis is missing or incomplete • Terminology is inappropriate • Evaluation, analysis and connections are missing, inadequate or inappropriate • Connections to concepts are absent • There is no recommendation for future study or improvement	• Multiple instances of damaged equipment • Responsibility for completing lab tasks was placed solely on a single individual or group members quarreled • There was a safety infraction *Severity of infraction may override this scoring rubric and result in removal from class and / or other appropriate disciplinary action.*	• Work shows significant errors in grammar, punctuation and / or spelling errors • Responses are illegible and / or sentence fragments • Lab is sloppy or disorganized; it appears that the lab was delivered o the teacher by being shot out of a cannon • The components of the lab are in the incorrect order
Self-Assessment				
Instructor Assessment				

*Students scoring in this range for a criterion are strongly encouraged to schedule a conference with the instructor.
Note: Labs submitted without self-assessments will not be accepted.

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