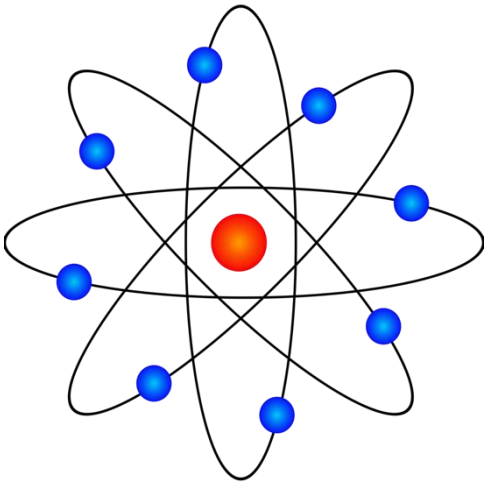
Fairbanks North Star Borough School District

SCIENCE CURRICULUM



APPENDIX

Revised June 2018

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The 5E Model of Instruction

5E Definition	Teacher Behavior	Student Behavior
Engage		
• Generate interest • Access prior knowledge • Connect to past knowledge • Set parameters of the focus • Frame the idea	• Motivates • Creates interest • Taps into what students know or think about the topic • Raises questions and encourages responses	• Attentive in listening • Ask questions • Demonstrates interest in the lesson • Responds to questions demonstrating their own entry point of understanding
Explore		
• Experience key concepts • Discover new skills • Probe, inquire, and question experiences • Examine their thinking • Establish relationships and understanding	• Acts as a facilitator • Observes and listens to students as they interact • Asks good inquiry-oriented questions • Provides time for students to think and to reflect • Encourages cooperative learning	• Conducts activities, predicts, and forms hypotheses or makes generalizations • Becomes a good listener • Shares ideas and suspends judgment • Records observations and/or generalizations • Discusses tentative alternatives
Explain		
• Connect prior knowledge and background to new discoveries • Communicate new understandings • Connect informal language to formal language	• Encourages students to explain their observations and findings in their own words • Provides definitions, new words, and explanations • Listens and builds upon discussion from students • Asks for clarification and justification • Accepts all reasonable responses	• Explains, listens, defines, and questions • Uses previous observations and findings • Provides reasonable responses to questions • Interacts in appositive, supportive manner
Extend/Elaborate		
• Apply new learning to a new or similar situation • Extend and explain concept being explored • Communicate new understanding with formal language	• Uses previously learned information as a vehicle to enhance additional learning • Encourages students to apply or extend the new concepts and skills • Encourages students to use terms and definitions previously acquired	• Applies new terms and definitions • Uses previous information to probe, ask questions, and make reasonable judgments • Provides reasonable conclusions and solutions • Records observations, explanations, and solutions
Evaluate		
• Assess understand (self, peer, and teacher evaluation) • Demonstrate understanding of new concept by observation or open-ended response • Apply within problem situation • Show evidence of accomplishment	• Observes student behaviors as they explore and apply new concepts and skills • Assesses students' knowledge and skills • Encourages students to assess their own learning • Asks open-ended questions	• Demonstrates an understanding or knowledge of concepts and skills • Evaluates his/her own progress • Answers open-ended questions • Provides reasonable responses and explanations to events or phenomena

Internet Science Resources

Alphabetized List of 60+ Science Websites	www.teachersfirst.com
Alaska Committee for Noxious & Invasive Plants & Management	www.uaf.edu/ces/cnipm/datareports.html
Alaska Department of Fish & Game • ADF&G Wildlife Notebook Series • SoundsWild • Creamer's Field • Funtastic Facts About Alaska's Wildlife • Project Wild • Alaska Wildlife Curriculum	www.adfg.state.ak.us www.projectwild.org
Alaska Mineral & Energy Resource Education Fund	www.ameref.org
Alaska Seas & Rivers Curriculum	http://seagrant.uaf.edu/marine-ed/curriculum
Alaska Science Teachers Association	http://asta.wildapricot.org
Alaska State Library	http://library.state.ak.us
Alaska Volcano Observatory	www.avo.alaska.edu
Arctic Studies Center, Arctic Wildlife	www.mnh.si.edu/arctic/html/wildlife.html
Biomedical Engineering	http://bmes.org
Center for Disease Control	www.cdc.gov
Climate Change	www.climate.be/textbook
Cooperative Extension Service	www.alaska.edu/uaf/ces/directory
Culturally Responsive Science Curriculum	www.ankn.uaf.edu/publications/handbook/front.html
International Polar Year Education Outreach	www.ipy.org/index.php?/ipy/audience/C27
Invasive Plants of Alaska	www.fs.fed.us/r10/spf/fhp/weed_book/index.htm
Investigating Forensics	www.sfu.museum/forensics/eng/pg_media-media_pg/professeur-pdfs-teachers
Next Generation Science Standards	www.nextgenscience.org
Noxious Plants	www.keystonecurriculum.org
FNSBSD Library Media Services	http://destiny.northstar.k12.ak.us
National Geographic	www.nationalgeographic.com
National Science Teachers Association • Science Notebooks Article • Discovery Center Articles • Constructivist Articles • Outstanding Science Trade Books for K-12 Students	www.nsta.org/publications/ostb
Process Skills	www.nsf.gov/pubs/2000/nsf99148/ch_7.htm
Public Lands Information Center	www.nps.gov/aplic/center
Rubistar (Rubrics)	http://rubistar.4teachers.org/index.php
Rubrics	http://www2.gsu.edu/~mstnrhx/457/rubric.htm
Rubrics For Assessment: University of Wisconsin	www.uwstout.edu/soe/profdev/rubrics.shtml
Science NetLinks	www.sciencenetlinks.com
Teachnology	http://teachers.teach-nology.com/web_tools/rubrics/lab_report
UAF Science Teacher Education Program (STEP)	www.gi.alaska.edu/STEP/index.html

NOTE: Due to the dynamic of the Internet, websites are subject to change and should always be viewed before student use.

K-5 Science Vocabulary Words

KINDERGARTEN				
Animal	Land	Pattern	Record	Sun
Collide	Light	Plant	Rock	Temperature
Direction	Living	Pull	Sand	Water
Earth	Measure	Push	Snow	Weather
Environment	Motion	Rain	Soil	Wind
Habitat	Non-living	Ramp	Speed	
FIRST GRADE				
Behavior	Grow	Offspring	Sound	Survive
Camouflage	Hibernate	Process	Star	Tools
Design	Illuminate	Protect	Stem	Vibrate
Device	Leaves	Roots	Sunrise	Young
External	Moon	Seed	Sunset	
Flowers	Observe	Sky	Surface	
SECOND GRADE				
Absorbency	Earth Event	Investigation	Observations	Solid
Analyze	Earthquakes	Irreversible	Observation Skills	Solution
Bodies of Water	Erosion	Land	Physical Characteristics	Strength
Color	Flexibility	Liquid	Physical Model	Texture
Data	Function	Man-Made	Pollinate	Timescale
Dispersal	Gas	Matter	Reversible	Volcanic Explosion
Diversity	Habitat	Model	Sensory	
Drawing	Hardness	Natural World	Sketch	

Third Grade				
Advantage	Individuals	Contact	Represent	Species
Argument	Influence	Describe	Effect	Traits
Balanced	Inherit	Magnetic	Electric	Typical
Cause	Interaction	Mates	Evidence	Unbalanced
Forces	Interpret	Merit	Explanation	Variation
Fossils	Life Cycles	Object	Reproduction	Weather Conditions
Hazard	Characteristics	Organisms	Season	
Impact	Claim	Reduces	Similar	
Fourth Grade				
Aesthetic	Food Chain	Law	Pollination	Space
Attraction	Force	Mass	Pollution	Speed
Axis	Galaxy	Metal	Producer	Subjectivity
Base	Germination	Metamorphic	Recycling	Supernatural
Conductor	Gravity	Metamorphosis	Scientific Method	Telescope
Conversation of Mass	Heat	Milky Way Galaxy	Scientist	Theory
Electricity	Heredity	Mineral	Sedimentary	Vacuum
Energy	Hypothesis	Objectivity	Sexual Reproduction	Vibration
Experiment	Igneous	Organism	Solar System	Volume
Fertilization	Inference	Pollen	Sound Wave	Weight
Fifth Grade				
Adaptation	Consumer	Force	Organ	Sense
Asteroid	Dissolve	Freeze	Planet	Skeleton
Atom	Evaporation	Humidity	Power	Speed
Circuit	Evolution	Microscope	Precipitation	Variable
Comet	Exoskeleton	Orbit	Repulsion	Water Cycle

Safety in the Classroom

Science Laboratory Rules & Regulations

Standards of Student Conduct in the Laboratory & in the Field

1. Conduct yourself in a responsible manner at all times in the laboratory. Frivolous activities, mischievous behavior, throwing items, and conducting pranks are prohibited.
2. Lab and safety information and procedures must be read ahead of time. All verbal and written instructions shall be followed in carrying out the activity or investigation.
3. Eating, drinking, gum chewing, applying cosmetics, manipulating contact lenses, and other unsafe activities are not permitted in the laboratory.
4. Working in the laboratory without the instructor present is prohibited.
5. Unauthorized activities or investigations are prohibited. Unsupervised work is not permitted.
6. Entering preparation or chemical storage areas is prohibited at all times.
7. Removing chemicals or equipment from the laboratory is prohibited unless authorized by the instructor.

Personal Safety

8. ANSI Z87.1 approved chemical splash goggles or safety glasses, as appropriate or directed by your instructor, shall be worn at all times in the laboratory or field, including pre-laboratory work and clean-up, unless the instructor specifically states that the activity does not require the use of chemical splash goggles or safety glasses.
9. When an activity requires the use of laboratory aprons, the apron shall be appropriate to the size of the student and the hazard associated with the activity or investigation. The apron shall remain tied throughout the activity or investigation.
10. All accidents, chemical spills, and injuries must be reported immediately to the instructor, no matter how trivial they may seem at the time. Follow your instructor's directions for immediate treatment.
11. Dress appropriately for laboratory work by protecting your body with clothing and shoes. This means that you should use hair ties to tie back long hair and tuck into the collar. Do not wear loose or baggy clothing or dangling jewelry on laboratory days. Acrylic nails are also a safety hazard near heat sources and should not be used. Sandals or open-toed shoes are not to be worn during any lab activities. Refer to pre-lab instructions. If in doubt, Ask!
12. Know the location of all safety equipment in the room. This includes eye wash stations, the deluge shower, fire extinguishers, the fume hood, and the safety blanket. Know the location of emergency master electric and gas shut offs and exits.
13. Certain classrooms may have living organisms including plants in aquaria or other containers. Students must not handle organisms without specific instructor authorization. Wash your hands with soap and water after handling organisms and plants.
14. When an activity or investigation requires the use of laboratory gloves for hand protection, the gloves shall be appropriate for the hazard and worn throughout the activity.

Specific Safety Precautions Involving Chemicals & Lab Equipment

15. Avoid inhaling in fumes that may be generated during an activity or investigation.
16. Never fill pipettes by mouth suction. Always use the suction bulbs or pumps.
17. Do not force glass tubing into rubber stoppers. Use glycerin as lubricant and hold the tubing with a towel as you ease the glass into the stopper.
18. Proper procedures shall be followed when using any heating or flame producing device especially gas burners. Never leave a flame unattended.
19. Remember that hot glass looks the same as cold glass. After heating, glass remains hot for a very long. Determine if an object is hot by placing your hand close to the object but do not touch it.
20. Should a fire drill or other evacuation emergency occur during an investigation or activity, make sure you turn off all gas burners and electrical equipment and exit the room as directed.
21. Always read the reagent bottle labels twice before you use the reagent. Be certain the chemical you use is the correct one.
22. Replace the top on any reagent bottle as soon as you have finished using it and return the reagent to the designated location.
23. Do not return unused chemicals to the reagent container. Follow the instructor's directions for the storage or disposal of these materials.

Standards For Maintaining A safer Laboratory Environment

24. Backpacks and books are to remain in an area designated by the instructor and shall not be brought into the laboratory area.
25. Never sit on laboratory tables.
26. Work areas should be kept clean and neat al all times. Work surfaces are to be cleaned at the end of each laboratory or activity.
27. Solid chemicals, metals, matches, filter papers, broken glass, and other materials designated by the instructor are to be deposited in the proper waste containers, not in the sink. Follow your instructor's directions for disposal of waste.
28. Sinks are to be used for the disposal of water and those solutions designated by the instructor. Other solutions must be place in the designated waste disposal containers.
29. Glassware is to be washed with hot, soapy water and scrubbed with the appropriate type and sized brush, rinsed, dried, and returned to its original location.
30. Goggles are to be worn during the activity or investigation, clean up, and through hand washing.

From the National Science Teachers Association (NTSA)
www.nsta.org/pdfs/SafetyInTheScienceClassroom.pdf

Science Reflection Journal

Name: _____
Date: _____

In our last class we: _____

I learned: _____

I think: _____

Other questions I have are: _____

Lab Report Form

Name:	***Date:***
Material(s) Needed	
Procedure	
Question	
Hypothesis	
Observation(s)	
Result(s)	
Conclusion	
Source(s)	

Sample Format and Scoring Guide for Formal Laboratory Reports

- A lab report is an assessment of your work—just like a test or quiz. You are expected to demonstrate your intellectual growth in each report you write.
- Lab reports are to be *typed*, double spaced and in standard font and standard margins.
- Each lab report is due 1 week following the completion of the lab.
- Lab reports should be 1-2 pages long, including data tables, graphs and calculations.
- This format MUST be followed, and each heading should be in bold.
- All writing should be clear and concise, avoiding scientific jargon and big words.
- The work was done by you in the past. Write in *active voice, past tense*.

_____/5 Title

A descriptive title is required. (Do not use the word "lab" in the title. In fact, do not use the word lab anywhere in your report!)

_____/15 Introduction

In your own words explain the purpose of the experiment. State the topic of your report clearly and concisely, in *one or two* sentences. Then, provide whatever background theory, previous research, or formulas the reader needs to know. I look for 3 things in the introduction: the purpose, the balanced chemical formula (explained), and all formulas/concepts (also explained). Cite at least one outside source from a reputable journal.

_____/5 Procedure

Describe your experiment in chronological order. Do not list the equipment separately. Use clear paragraph structure and explain the steps in the order they actually happened—not what was supposed to happen. Do not number your steps. Write clearly enough that someone (like me) who is familiar with the experiment could repeat your procedure exactly. You may use the lab handout, but you must use your own words. Be concise—no more than a couple paragraphs.

_____/20 Data/Observations

Your data should be in the form of a table with all columns labeled and units included in the column headings. Include a graph if appropriate. All graphs and tables must be *numbered and titled*. Use a sentence or two to draw attention to key points in the tables/graphs and state the key result in sentence form. You may do your calculations *and only your calculations!* by hand. Explain your calculations with text comments.

_____/30 Discussion

The discussion is the most important part of your report, because here, you show that you understand the experiment beyond the simple level of completing it. "What is the significance or meaning of the results?" To answer this question, you must analyze and interpret your results. What do the results indicate clearly? What have you found?

Explain what you know with certainty based on your results and draw conclusions. What is the significance of the results? What ambiguities exist? What questions might you raise? Find logical explanations for problems in the data. Some hints to help you write a good discussion section follow:

- Compare expected results with those you obtained. If there were differences, how can you account for them? Saying "human error" implies you're incompetent. Be specific, but do not blame your equipment or your lab partners. Look for environmental factors or other factors that could explain differences.
- Analyze experimental error. If the flaws result from the experimental design, explain how the design might be improved.
- Explain your results in terms of theoretical issues. The labs are intended to illustrate important physical laws, such as Boyle's Law. Usually you will have discussed these in the introduction. In this section move from the results to the theory. How well has the theory been illustrated?
- Relate results to your experimental objective(s). If you set out to identify an unknown metal by finding its specific heat, you'd better know the metal's specific properties and its attributes.
- Compare your results to similar investigations. In some cases, it is legitimate to compare outcomes with classmates, not to change your answer, but to look for any anomalies between the groups and discuss those. (From www.ecf.utoronto.ca)

The discussion is the most important part of your lab report and is graded accordingly. You must show me, through your writing that you understand the concepts covered in the lab. The conclusion (last couple paragraphs) can be very short. Simply state what you know now, for sure as a result of the lab. Include a justification. The conclusion might also be a place to discuss weaknesses of experimental design, what future work needs to be done to extend your conclusions, or what the implications of your conclusion are.

_____/5 Sources

Use APA formatting. The author's last name is left justified, and the remaining information is indented. At least one outside source is required.

- The report will also be graded on formatting, style, spelling, verb tense, active voice, etc.
- Your formal lab report must be turned in with your lab notebook which includes your pre-lab, all your lab data, complete calculations, observations and discussion questions answered. *(20 points)*
- I will gladly correct any lab turned in at least 2 days early, which gives students the opportunity to correct any shortcomings in their reports.

(***Developed by Greg Kahoe, West Valley High School, 2016***)

Sample Format and Scoring Guide - AP Chemistry Typed Lab Reports with Abstract

- A lab report is an assessment of your work - just like a test or quiz. You are expected to demonstrate your intellectual growth in each report you write.
- Lab reports are to be typed, double spaced and in standard font and standard margins.
- Lab reports should be 2-3 pages long, including data tables, graphs, and calculations.
- This format MUST be followed, and each heading should be in bold.
- All writing should be clear and concise, avoiding scientific jargon and big words.
- The work was done by you in the past. Write in active voice, past tense.

_____ /2 Title

A descriptive title is required. (Do not use the word "lab" in the title. In fact, do not use the word lab anywhere in your report!)

_____/10 Abstract

Your abstract must be less than 200 words long. It should include the main facts of your investigation including results, error, and discussion.

_____/10 Introduction

In your own words explain the purpose of the experiment. State the topic of your report clearly and concisely, in one or two sentences. Then, provide whatever background theory, previous research, or formulas the reader needs to know. I look for 3 things in the introduction: the purpose, the balanced chemical formula (explained), and all formulas/concepts (also explained). Cite at least one outside source from a reputable journal.

_____/5 Procedure

Describe your experiment in chronological order. Do not list the equipment separately. Use clear paragraph structure and explain the steps in the order they actually happened, not what was supposed to happen. Do not number your steps. Write clearly enough that someone (like me) who is familiar with the experiment could repeat your procedure exactly. You may use the lab handout, but you must use your own words. Be concise - no more than a couple paragraphs.

_____/20 Data/Observations

Your data should be in the form of a table with all columns labeled and units included in the column headings. Include a graph if appropriate. All graphs and tables must be numbered and titled. Use a sentence or two to draw attention to key points in the tables/graphs and state the key result in sentence fo1m. You may do your calculations, and only your calculations, by hand. Explain your calculations with text comments.

_____/30 Discussion

The discussion is the most important part of your report, because here you show that you understand the experiment beyond the simple level of completing it. "What is the significance or meaning of the results?" To answer this question, you must analyze and interpret your results. What do the results indicate clearly? What have you found?

Explain what you know with certainty based on your results and draw conclusions. What is the significance of the results? What ambiguities exist? What questions might you raise? Find logical explanations for problems in the data. Some hints to help you write a good discussion section follow:

- Compare expected results with those you obtained. If there were differences, how can you account for them? Saying "human error" implies you're incompetent. Be specific, but do not blame your equipment or your lab partners. Look for environmental factors or other factors that could explain differences.
- Analyze experimental error. If the flaws result from the experimental design, explain how the design might be improved.
- Explain your results in terms of theoretical issues. The labs are intended to illustrate important physical laws, such as Boyle's Law. Usually you will have discussed these in the introduction. In this section move from the results to the theory. How well has the theory been illustrated?
- Relate results to your experimental objective(s). If you set out to identify an unknown metal by finding its specific heat, you'd better know the metal's specific properties and its attributes.
- Compare your results to similar investigations. In some cases, it is legitimate to compare outcomes with classmates, not to change your answer, but to look for any anomalies between the groups and discuss those. (From www.ecf.utoronto.ca)

The discussion is the most important part of your lab report and is graded accordingly. You must show me, through your writing, that you understand the concepts covered in the lab. The conclusion (last couple paragraphs) can be very short. Simply state what you know now, for sure, as a result of the lab. Include a justification. The conclusion might also be a place to discuss weaknesses of experimental design, what future work needs to be done to extend your conclusions, or what the implications of your conclusion are.

_____/3 Sources

Use APA formatting. The author's last name is left justified, and the remaining information is indented. At least one outside source is required.

- The report will also be graded on formatting, style, spelling, verb tense, active voice, etc.
- Your formal lab report must be turned in with your lab notebook, which includes your prelab, all your lab data, complete calculations, and observations and discussion questions answered. (20 points)
- I will gladly correct any lab turned in at least 2 days early, which gives students the opportunity to correct any shortcomings in their reports.

(***Developed by Greg Kahoe, West Valley High School***)

Sample General Chemistry Lab Report Guidelines

Please Note:

- You must use complete sentences in every lab report, and you will be graded on grammar, spelling, and sentence structure. Please proofread your work before you hand it in.
- A lab report is an assessment of your work, just like a test or quiz. You are expected to demonstrate your intellectual growth in each report you write.
- Use the following headings in this order as the framework for your report.

Title: A descriptive title for each report is required.

Introduction: Provides the reader with background information about this experiment.

- **Purpose:** What are we trying to figure out by doing this experiment? This may be posed as a question.
- **Background Information:** In this section you will include information that applies to the problem that you are trying to solve. Sources for this information may include your class notes, your book, or sources such as other books or scientific journals. It should be summarized, but clear and in your own words.
- **Hypothesis**: What do you think will happen in this experiment? Why do you think this will happen based upon the background information you supplied in the previous paragraph?

Procedure: What steps did you go through to set up the experiment? The procedure you write should include the equipment you used, but the supplies should not be listed separately.

Data/Observations: Data are any results, measurements, observations, or outcomes of your experiment. You must record actual observations, not make generalizations. (ie: "We observed no change in the temperature" rather than "Nothing happened")

- Your data should be in the form of a table with all columns labeled and units included in the column headings.
- When appropriate, include a graph of your results. All graphs and tables must be numbered and titled. Each axis of the graph(s) must have a name and unit.
- **Data Summary:** Every graph should include a sentence or two to draw attention to key points or patterns in the tables/graphs.

Discussion: Recap the purpose of the experiment and remind the reader what you were trying to determine by doing this lab.

- Explain **why** your results turned out the way they did. Use terms from the background information section.
- Use your data/ observations to either support or not support your hypothesis.
- Discuss sources of error in this experiment (errors are different than mistakes!). Include a statistical analysis of your error if appropriate.
- Talk about new things you learned doing this lab. Include any further questions that may have been raised by your experiment. Address how you might change your experimental design if you were to do this again.

(***Developed by Greg Kahoe, West Valley High School***)

Sample Grading Rubric for Chemistry Lab Notebook

Note: Each lab will be neatly recorded in the lab notebook and grading accordingly. Some labs will also require a formal (typed) lab report.

	A	B	C	D/F
Introduction (Prelab)	2 to 3 sentences explaining the purpose of the lab and educational goal 2 pts	2 to 3 sentences that explain the lab purpose but fails to explain goals 1 pt	At least 2 sentences that mention what the lab is about. 1 pt	Less than two sentences or **1** run-on sentence that fails to inform the reader what to expect. 0 pts
Procedure (Prelab)	Complete and careful consideration of every lab step. Instructor does not need to give further advice or suggestions. Student does not have any accidents and uses equipment correctly. 3 pts	Lab directions are clearly laid out, but 1-2 steps are unclear, dangerous, or missmg. 2 pts	Lab directions are adequate, but not clear except to student. Student procedure is unsafe. 1-2 pt	Lab directions are inadequate and would result in dangerous situation. Student procedure is unsafe. 0-1 pt
Data table (Prelab)	Each table has a number and title (eg. *Table #1: Reactant masses).* All measurements are anticipated, table is drawn with straight edge, and units are included in the labeled columns. 5 pts	Table is missing number or title. Most measurements are anticipated, units are included in the labeled columns, and table is neat. 4 pts	Table lacks title/number. Most measurements are anticipated, table is sloppy, Some units/ labels are missing. 3-4 pts	Data table is either missing or not well-planned. 0-2 pts

	A	B	C	D/F
Data/calculations (post-lab)	Data table/ numbers are easy to read, include proper sig. figs. and all calculations are explained or clear enough to follow easily. 5 pts	Data table/ numbers are easy to read, include mostly proper sig. figs. and most calculations are explained or clear enough to follow with effort. 4 pts	Data entries are hard to read or clearly erroneous. Calculations are incorrect, lack sig. figs., units, or other qualifying information. 3 pts	Data entries are hard to read or clearly erroneous. Student is incapable of using lab data or does not demonstrate competence with calculations. 0-2 pts
Discussion (post-lab)	Student clearly understands lab and has achieved educational goals. Discussion is more than one paragraph and demonstrates knowledge about the lab learned outside the classroom. The student's results are the principal focus of the discussion. Error possibilities are reasonable, articulated and acknowledged. 9-10 pts	Student mostly understands lab. Discussion is more than one paragraph and demonstrates knowledge about the lab learned in classroom. Student uses discussion to explain results, but without good understanding of chemical concepts. Error possibilities are articulated and acknowledged. 7-8 pts	Student mostly understands lab. Discussion is one long, rambling paragraph that demonstrates some knowledge about the lab learned in classroom. Student spends significant part of discussion on components other than results. Error possibilities are unexplained. 6-7 pts	Student does not demonstrate knowledge about lab procedures necessary to conduct experiment. Errors are unexplained. 0-5 pts

(***Developed by Greg Kahoe, West Valley High School***)

Grading Rubric: Cu (I) or Cu (II) ? Lab

	Exceeds Expectations	Meets Expectations	Below Expectations
Introduction (Prelab)	2 3 sentences explaining the purpose of the lab, educational goals and description of technique (ie maximizing the precipitate to figure out the charge on the Cu ion.)	1 2 to 3 sentences that explain the lab purpose but fail to explain how student will accomplish goal.	0 Only one sentence that fails to inform the reader what to expect.
Procedure (Prelab)	5 4 Cartoon, or simple sketch for every lab step. Each step is clearly drawn so that someone could repeat this lab. Test tubes and well plate are drawn.	3 2 Even though each step is drawn with a sketch, it is unclear how to carry out the lab just by reading student sketches.	1 0 Lab directions are inadequate and would result in dangerous situation. Student procedure is unsafe.
Data tables (Prelab)	3 Each table has a number and title (eg. *Table #7: Drop Ratios of Cu and PO_4).* All measurements are anticipated, table is drawn with straight edge, units are included in the labeled columns.	2 1 Tables are missing number or title, or not drawn with a straight edge. Some units/labels are missing. Student data is inaccurate or measured using cm instead of mm.	0 Tables are sloppy, not well-planned or missing. Student data is inaccurate or measured using cm instead of mm.
Graph (post-lab)	10 9 8 The graph is clearly done with a computer, and has a title and number. It is a column graph. Each ratio is labeled on the x-axis. The y-axis is labeled *height of precipitate* (mm). The 9 ratios reflect the measurements in student's data table. The graph is taped into the lab notebook with no loose edges.	7 6 5 The graph is done with computer software, but either the x-axis or y-axis are unlabeled, or title and number are missing. The graph may be a line graph or some sort of bar graph that is incorrectly executed. Even a beautifully taped graph will receive a significant deduction if the graph is inaccurate.	4 3 2 1 The graph is not done with a computer, or is so poorly executed that it does not illustrate the student's data. A neat, handmade presentation could still net some points here. Lack of any graph results in 0 points.

	Exceeds Expectations	Meets Expectations	Below Expectations
Discussion (post-lab)	10 9 8	7 6 5 4	3 2 1 0
	The rough draft is strongly edited. Student clearly understands lab and has achieved educational goals. Typed discussion is more than two paragraphs, double-spaced, and demonstrates knowledge about the lab. The student's results (graph) are the principal focus of the discussion, yet the questions in the lab handout are answered thoughtfully. Student uses proper grammar, spelling, and transitions. Error possibilities (for instance, student's optimum ratio is neither +1 nor +2) are reasonable, articulated, and acknowledged. The final paragraph begins with "In conclusion," and includes the student's determination of the Cu ion charge and an idea to make this a more useful lab for future students.	The rough draft is included, but not heavily edited. Student mostly understands lab and has achieved educational goals. Typed discussion is more than two paragraphs and demonstrates knowledge about the lab. The student's results (graph) are the principal focus of the discussion. Some of the discussion prompts are unanswered. Student uses poor grammar, has misspelled words, and poor transitions between ideas. Error possibilities (for instance, student's optimum ration is neither +1 nor +2) are unreasonable or omitted. The final paragraph still begins with "In conclusion," but may not include the student's determination of the Cu ion charge or an idea to make this more useful lab for future students.	There is no rough draft. Student mostly understands lab. Discussion is one long, rambling paragraph that demonstrates some knowledge about the lab learned in the classroom. (An untyped discussion will incur penalty.) Student spends significant part of discussion on components other than results. Error possibilities are unexplained. Student does not demonstrate knowledge about lab and errors are not explained. Zero points if discussion is missing.

(***Developed by Greg Kahoe, West Valley High School***)

Science Pathway Options: Grades 9-12

Graduation Requirements: 1.0 credit Physical Science, 1.0 credit Biological Science, 1.0 Science Elective

<table>
<tr><th rowspan="2">Grade</th><th colspan="2">Option 1</th><th colspan="2">Option 2</th><th colspan="2">Option 3 (Standard)</th><th colspan="2">Option 4 (Honors)</th><th colspan="2">Option 5 (AP)</th></tr>
<tr><th>Semester 1</th><th>Semester 2</th><th>Semester 1</th><th>Semester 2</th><th>Semester 1</th><th>Semester 2</th><th>Semester 1</th><th>Semester 2</th><th>Semester 1</th><th>Semester 2</th></tr>
<tr><td rowspan="2">9th</td><td rowspan="2">Natural Resources: Physical Science A</td><td rowspan="2">Natural Resources: Physical Science B</td><td rowspan="2">Principles of Biomedical Science Semester 1</td><td rowspan="2">Principles of Biomedical Science Semester 2</td><td>Earth & Space Science Semester 1</td><td>Earth & Space Science Semester 2</td><td rowspan="2">Honors Biology A</td><td rowspan="2">Honors Biology B</td><td rowspan="2">AP Biology Semester 1</td><td rowspan="2">AP Biology Semester 2</td></tr>
<tr><td colspan="2">OR</td></tr>
<tr><td rowspan="3">10th</td><td rowspan="3">Natural Resources Biology A</td><td rowspan="3">Natural Resources Biology B</td><td>Biology Semester 1</td><td>Biology Semester 2</td><td>Biology Semester 1</td><td>Biology Semester 2</td><td colspan="2" rowspan="3">AP Science Course</td><td>AP Physics 1A Semester 1</td><td>AP Physics 1B Semester 2</td></tr>
<tr><td colspan="2">OR</td><td colspan="2">OR</td><td colspan="2">OR</td></tr>
<tr><td>eLearning Biology Semester 1</td><td>eLearning Biology Semester 2</td><td>eLearning Biology Semester 1</td><td>eLearning Biology Semester 2</td><td>AP Chemistry Semester 1</td><td>AP Chemistry Semester 2</td></tr>
<tr><td rowspan="6">11th</td><td>Chem Tech Semester 1</td><td>Chem Tech Semester 2</td><td>Chemistry Semester 1</td><td>Chemistry Semester 2</td><td>Chemistry Semester 1</td><td>Chemistry Semester 2</td><td colspan="2" rowspan="6">AP Science Course</td><td>AP Physics 2A Semester 1</td><td>AP Physics 2B Semester 2</td></tr>
<tr><td colspan="2">OR</td><td colspan="2">OR</td><td colspan="2">OR</td><td colspan="2">OR</td></tr>
<tr><td colspan="2" rowspan="3">Science Elective Semesters 1 & 2</td><td>eLearning Chemistry Semester 1</td><td>eLearning Chemistry Semester 2</td><td>eLearning Chemistry Semester 1</td><td>eLearning Chemistry Semester 2</td><td>AP Physics 1A Semester 1</td><td>AP Physics 1B Semester 2</td></tr>
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<tr><td>12th</td><td colspan="2">Elective</td><td colspan="2">Elective</td><td colspan="2">Elective</td><td colspan="2">AP Science Course
OR
Elective</td><td>AP Physics C: Mechanics A Semester 1</td><td>AP Physics C: Mechanics B Semester 2</td></tr>
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PHYSICAL SCIENCE OPTIONS				
AP Chemistry (semesters 1 & 2)	AP Physics A/B (semesters 1 & 2)	AP Physics 2 A/B (semesters 1 & 2)	AP Physics C: Mechanics A/B (semesters 1 & 2)	Chemistry (semesters 1 & 2)
Chem Tech (semesters 1 & 2)	Conceptual Physics (semesters 1 & 2)	Earth & Space Science (semesters 1 & 2)	eLearning Chemistry (semesters 1 & 2)	eLearning Earth Science (semesters 1 & 2)
eLearning Physical Science (semesters 1 & 2)	eLearning Physics (semesters 1 & 2)	Natural Resources: Physical Science A/B (semesters 1 & 2)	Physical Science (semesters 1 & 2)	Physics (semesters 1 & 2)
Principles of Engineering A/B (semesters 1 & 2)				
BIOLOGICAL SCIENCE OPTIONS				
AP Biology (semesters 1 & 2)	Biology (semesters 1 & 2)	eLearning Biology (semesters 1& 2)	Honors Biology (semesters 1 & 2)	Natural Resources: Biology A/B (semesters 1 & 2)
Principles of Biomedical Sciences (semesters 1 & 2)				
SCIENCE ELECTIVE OPTIONS				
AP Environmental Science (semesters 1 & 2)	Alaska Zoology: Fish & Birds	Alaska Zoology: Mammals	Astrobiology	Astronomy
Forensic Science	Advanced Forensic Science	eLearning Environmental Science (semesters 1 & 2)	Geology	Human Anatomy & Physiology
Human Body Systems A/B	Introduction to Basic Pathophysiology	Marine Biology	Medical Terminology 1A/1B	Microbiology & Botany

Scientists

KINDERGARTEN		
John Muir	1838-1914	A Scottish-American philosopher, naturalist, and author who campaigned for the conservation of land, water, and forests in the United States.
Susan La Flesche Picotte	1865-1915	The first Native American female physician.
Jonas Salk	1914-1995	An American medical researcher and virologist who is recognized for developing a vaccine that became the first weapon in preventing polio.
FIRST GRADE		
George Washington Carver	1864?-1943	An African-American botanist and inventor who won international fame for his agricultural research and promotion of alternative crops to cotton, such as peanuts and sweet potatoes.
Orville Wright	1871-1948	American brothers, inventors, and aviation pioneers who are credited with inventing and building the world's first successful airplane.
Wilbur Wright	1867-1912	
Louis Pasteur	1822-1895	A French chemist and microbiologist who made major contributions to chemistry, medicine, and industry that have greatly benefited humanity.
SECOND GRADE		
Alexander Graham Bell	1847-1922	A Scottish-born scientist, inventor, engineer and innovator who is credited with patenting the first practical telephone.
Jane Goodall	1934-	A British primatologist, ethologist, anthropologist, and a United Nations Messenger of Peace who is considered to be the world's foremost expert on chimpanzees and her 55-year study of social and family interactions of wild chimpanzees.
Nicolaus Copernicus	1473-1543	A Polish Renaissance mathematician, astronomer, and considered the founder of modern astronomy, who formulated a model of the universe that placed the Sun rather than the Earth at center of the universe.
THIRD GRADE		
Elizabeth Britton	1858-1934	An American botanist, bryologist, educator, and activist for the protection of numerous endangered wildflower species across the country.
Thomas Edison	1847-1931	An American inventor and businessman who developed many devices that greatly influenced life around the world, including the phonograph, the motion picture camera, and the light bulb and created the first industrial research laboratory.
Elijah McCoy	1843-1929	A Canadian-American inventor and engineer of African descent who invented the automatic lubricator, which continuously supplies lubricants to moving parts of various types of machines.

FOURTH GRADE		
Mary Leakey	1913-1996	A British paleoanthropologist who discovered the first fossils, tools, and evidence of prehistoric human beings in Africa
Carl Sagan	1934-1996	An American astronomer, cosmologist, astrophysicist, astrobiologist, author, and science popularizer and communicator in astronomy who contributed to the discovery of high surface temperatures on Venus and research of extraterrestrial life.
Rachel Carson	1907-1964	An American marine biologist, conservationist, and author who is credited with advancing the global environmental movement.
FIFTH GRADE		
Jacques Cousteau	1910-1997	A French naval officer, explorer, conservationist, filmmaker, innovator, scientist, photographer, author, and researcher who studied the sea and all forms of life in water, co-developed the Aqua-lung, and pioneered marine conservation.
Alfred Wegener	1880-1930	A German polar researcher, geophysicist, and meteorologist who is the originator of the theory of continental drift by hypothesizing that continents are slowly drifting around the Earth.
Anton Van Leeuwenhoek	1632-1723	A Dutch tradesman, scientist, and the first microbiologist who is known for recording observations of microscopic life and provided the first clear descriptions of bacteria.
Fridtjof Nansen	1861-1930	A Norwegian polar explorer, scientist, diplomat, humanitarian, a marine zoologist, a pioneer oceanographer, and Nobel Peace Prize laureate whose research on the central nervous system of lower marine creatures established the modern theories of neurology.
SIXTH GRADE (MIDDLE SCHOOL)		
Leonardo da Vinci	1452-1519	An Italian polymath who was one of the greatest painters and most versatile geniuses in history who studied anatomy, astronomy, botany, geology, geometry, optics, and designed machines and drew plans for hundreds of inventions.
Marie Curie	1867-1934	French physicists and chemist who conducted pioneering research on radioactivity and Marie was the first female Nobel Prize winner and the first person and only woman to win twice in multiple sciences.
Pierre Curie	1859-1906	
Sir Isaac Newton	1642-1727	An English physicist, mathematician, scientist, and astronomer who invented a new kind of mathematics, discovered the secrets of light and color, and showed how the universe is held together.
Michael Faraday	1791-1867	An English scientist, chemist, and physicist who discovered electromagnetic induction, diamagnetism, and electrolysis.

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