



University of Management & Technology
School of Science
Department of Chemistry

CH-603 NATURAL PRODUCT CHEMISTRY

Lecture Schedule	Once a week (06:30 – 09:15 pm)	Semester	Spring/Fall
Pre-requisite	Graduate Standing (General Chemistry)	Credit Hours	3
Instructor(s)	Dr Sammia Shahid	Contact	sammia.shahid@umt.edu.pk Extension. 3614
Office	2 nd Floor, Center Block, C3-26	Office/Counseling Hours	As per faculty Semester Timetable
Program Learning Objectives	<p>The aim of graduate education is to create individuals with the capacity to learn independently and the ability to define and solve new problems. Chemists with graduate degrees are people who can both advance the fundamental understanding of their discipline and communicate what they have learned to others.</p> <p>Program Learning Objectives:</p> <ul style="list-style-type: none">➤ to demonstrate an advanced understanding of selected topics in chemistry,➤ to demonstrate information literacy skills for acquiring knowledge of chemistry, both as a student and as a life-long learner,➤ to demonstrate an understanding of experimentation, observation, and data analysis, and their application to defined questions in chemistry,➤ to demonstrate familiarity with available instrumentation for conducting specific scientific research,➤ to communicate effectively, verbally and written, for the purposes of conveying chemical information to both professional scientists and the public.		
Course Learning Objectives	<p>Course main objective is to make the students acquainted to the basic concept of natural product chemistry The objectives of the course are:-</p> <ol style="list-style-type: none">1. To understand the field of natural products chemistry and to identify their probable biosynthetic pathways2. To acknowledge the importance of natural compounds as lead molecules for new drug discovery3. To be able to Isolation, purification, and characterization of simple chemical constituents from the natural source		

	4. To enhance understanding of nature of chemical materials and the emerging trends.
Course Description	Natural Products Chemistry is a course in the chemistry discipline area. The contemporary role of secondary natural products in health care will be explored. Students will learn how natural products are normally classified according to their biosynthetic origins and chemical properties. A special emphasis will be placed on how chemical structure affects the physiological function of various natural products. These "structure-activity relationships" help us learn about the interaction of small molecules in living systems and the pharmacology of drugs. Since this is an upper-level course it will be assumed that students are able and equipped to do research in an area that is somewhat new to them. Instead of reviewing and applying lecture material, much of the homework will involve discovering and researching in areas related to topics the lectures have not yet covered. This course adopts a multi-disciplinary approach to the subject of natural products; therefore we will draw from the fields of chemistry, biochemistry, molecular biology, botany, clinical medicine, pharmacology, and pharmacognosy.
Expected Learning Outcomes	<p>Upon successful completion of the course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Explain what natural products are, understand the different types of natural products and give various examples of natural products 2. Acquire the knowledge of the key biosynthetic pathways for the biosynthesis of flavonoids, fatty acids, polyketides, terpenes, and alkaloids 3. Apply the concept of natural chemistry in the identification of natural compounds. 4. Describe the chemical properties of natural products & state the applications of these natural products 5. Analyze and interpret the structural elucidation of compounds of natural origin 6. Improve research skills and critical thinking skills. 7. Apply the concept of natural chemistry in the development of lead molecules for new drug discovery <p>We will perform some traditional assignments such as quizzes, worksheets, and formal papers. We will also attempt several non-traditional assignments such as class presentations, group projects, and article reviews. This course requires a significant amount of self-discipline and independent motivation.</p>
Recommended Text Books	<ol style="list-style-type: none"> 1) IL. Finar; Organic Chemistry, Vol. 2: Stereochemistry and the Chemistry of Natural Products, Latest Edition, Pearson Education. 2) Sujata V. Bhat, Bhimson A. Nagasampagi, Meenakshi Sivakumar; Chemistry of Natural Products, Narosa Publishing House, Latest edition. 3) Raymond Cooper, George Nicola, Natural Products Chemistry; Sources, Separations and Structures , ISBN 9781466567610, Published by CRC Press, latest edition
Recommended Reference Books	<ol style="list-style-type: none"> 1) Core Concepts in Supramolecular Chemistry and Nanochemistry, Jonathan W. Steed, David R. Turner, Karl J. Wallace, Latest Ed, John Wiley & Sons, Ltd, Latest edition. 2) Nanoscale Materials in Chemistry, Kenneth J. Klabunde, John Wiley & Sons, Ltd. Latest edition. 3) J. Mann, Secondary Metabolism, Latest edition., Oxford University Press, New York.

Assessment Criteria	<ul style="list-style-type: none"> • Quizzes: 10% • Assignments: 05% • Presentations: 05% 	<ul style="list-style-type: none"> • Case Study: 05 % • Midterm: 25% • Final Exam: 50%
Course Delivery	<p>To meet course objectives, the delivery of CH 603 will be accomplished through a combination of in-class collaborative work groups, dialogic discussions, individually written reflections and mini-lectures designed to help meet the needs of all learners and learning preferences. These include:</p> <ul style="list-style-type: none"> ➤ Presentations (i.e., mini-lectures, often assisted by PowerPoint and other visuals); ➤ Discussions (i.e., active involvement of students in learning by asking questions that provoke critical thinking and verbal interaction); ➤ Cooperative learning (i.e., small group structure emphasizing learning from and with others); ➤ Collaborative learning (i.e., heterogeneous groups in an interdisciplinary context); ➤ Student sharing and mini-presentations; ➤ Web-based journaling; ➤ Learning Management System- Moodle-web-based course management and portal system. 	
Classroom Behavior	<p>Regularity and punctuality will be very strictly observed. You have an allowance of only three absences (<u>Out of 16 sessions</u>). This includes the leaves that are approved from your Batch Advisor. In case you are absent in four classes, you will get an 'F' in the course. Regarding punctuality, you will be marked present only if you arrive in the class within five minutes of the scheduled time. Any absents during the presentation sessions will result in deduction of 1 point each from the presentation marks. If your group is making a presentation and you are not there, you get a zero. If you miss a Quiz you get zero in that Quiz. You will lose 5 points if you deliver your assignment / report after the given date. The chapters and other material included in the Mid-term and final Exam will be discussed one week prior to its commencement respectively.</p>	
Participant Responsibilities	<p><i>Class Participation:</i> Positive, healthy and constructive class participation will be monitored for each class. Particular emphasis will be given during the presentation sessions. The manner in which the question is asked or answered will also be noted.</p> <p><i>Honesty Policy:</i> A student found in cheating (<u>plagiarism</u>) on any exam/ assignment/ project, his/her case will be referred to Unfair Means Committee (UFM) that may result in no credit (i.e. no grade) for that exam/ assignment/ project. A deduction from the sessional marks and financial penalties are other possibilities as decided by the committee.</p> <p><i>Plagiarism:</i> It is defined in dictionaries as "the wrongful appropriation, close imitation, or purloining (stealing) and publication, of another author's language, thoughts, ideas, or expressions, and the representation of them as one's own original work. HEC Plagiarism policy will be followed.</p>	

Course Schedule/ Calendar of Activities

Weeks	Topics	Activities	Assignments & Tasks	Readings	Learning Outcomes/Objectives
1st	Introduction to natural products Classification of natural products, Metabolic pathways	Introduction Video Clip Presentation Discussion	Formative: Formative: PMI	Raymond Nicola Ch # 1 & 2	students will be able to: ❖ provide an overview of the field of natural product chemistry. ❖ identify different types of natural products, their occurrence, structure, biosynthesis and properties. ❖ discuss the use of natural products as starting materials for medicines. ❖ carry out independent investigations of plant materials and natural products.
2nd	Herbal medicine; antiviral and anticancer drugs Plant derived medicines	Presentation Discussion Video Clip	Summative: Assignment # 1	IL Finar Ch # 18	students will: ❖ be able to identify medicinal plants (family/genus - level) ❖ identify by name and understand the effects of plant chemical constituents on humans ❖ be able to clearly and logically articulate their ideas in writing and orally ❖ be able to find reliable information about medicinal plants and herbal supplements at the library or on the internet ❖ demonstrate understanding of the importance of medicinal plants among different cultures through clear, logical writing ❖ demonstrate how different cultures approach plant use in different ways and how plants and people interact. ❖ apply basic ethnobotanical techniques to the study of a specific cultural use of medicinal plants. ❖ be able to logically defend a position regarding the intersection of religion, government regulation and healthcare. ❖ Know the contribution of natural products to the drug discovery process
3rd	Flavonoids Classification, Biogenesis, Separation Techniques Pharmaceutical Applications	Lecture Presentation Group Discussion	Summative: Quiz # 1 Formative: Headlines	SV Bhat Ch # 9	students will be able to: ❖ define and classify flavonoids ❖ learn the useful and noxious effects of flavonoids on human health. ❖ learn the extractions procedure and route of administration of flavonoids

					<ul style="list-style-type: none"> ❖ learn the definition and classification of flavonoids ❖ able to describe biological activities, bioavailability and plant/food sources of flavonoids and natural antioxidants. ❖ perform a correct bibliographical research on subjects covered during the course.
4 th	Biosynthesis of flavonoids by different routes	Lecture Presentation Group Discussion	Summative: Quiz # 2	SV Bhat Ch # 9	<p>students will be able to:</p> <ul style="list-style-type: none"> ❖ explain various routes of biosynthesis of flavonoids ❖ understand the occurrence, bioactivities, physico-chemical and analytical properties as well as biosynthesis of plant secondary metabolites. ❖ understand the characteristics of the most important compound groups affecting biosynthesis ❖ follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an various classes of natural products biosynthesis or a determination of the structure of terpenes, steroids, alkaloids, flavonoids
5 th	Terpenoids Classification, Separation Techniques Pharmaceutical Applications	Lecture Presentation Group Discussion Case Study Topics will be discussed	Summative: Quiz # 3 Student Presentations** Formative: Exit Slip	SV Bhat Ch # 2	<p>students will be able to:</p> <ul style="list-style-type: none"> ❖ Learn the different types of terpenes, terpenoids and their chemistry and medicinal importance. ❖ Explain the importance of natural compounds as lead molecules for new drug discovery. ❖ Learn the constituent present in crude drugs responsible for pharmacological activities ❖ Elaborate general methods of structural elucidation of compounds of natural origin. ❖ Learn advanced methods of structural elucidation of compounds of natural origin. ❖ Understand isolation, purification and characterization of simple chemical constituents from the natural source
6 th	Biosynthesis of terpenoids by different routes	Lecture Presentation Group Discussion	Summative: Assignment # 2 Student Presentations	SV Bhat Ch # 2	<p>students will be able to:</p> <ul style="list-style-type: none"> ❖ understand the occurrence, chemical composition and biosynthesis of plant secondary metabolites ❖ identify natural products and their probable

			Formative: Think-Pair-Share		<p>biosynthetic pathways;</p> <ul style="list-style-type: none"> ❖ enhance their understanding of biological and biochemical sciences. ❖ follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an various classes of natural products biosynthesis or a determination of the structure of terpenes, steroids, alkaloids, flavonoids
7 th	<p>Steroids Classification, Separation Techniques Pharmaceutical Applications</p>	<p>Lecture Presentation Group Discussion</p>	<p>Summative: Quiz # 4 Student Presentations</p> <p>Formative: One Minute Paper</p>	<p>SV Bhat Ch # 1</p>	<p>students will be able to:</p> <ul style="list-style-type: none"> ❖ Learn the different types of steroids and their chemistry and medicinal importance. ❖ Explain the importance of natural compounds as lead molecules for new drug discovery. ❖ Learn the constituent present in crude drugs responsible for pharmacological activities ❖ Elaborate general methods of structural elucidation of compounds of natural origin. ❖ Learn advanced methods of structural elucidation of compounds of natural origin. ❖ Understand isolation, purification and characterization of simple chemical constituents from the natural source ❖ understand the role of natural products in living organisms, their biosynthesis and will have a greater understanding of organic synthesis with natural product targets
8 th	<p>Biosynthesis of steroids</p>	<p>Lecture Presentation Group Discussion Video Clip</p>	<p>Summative: Student Presentations Formative: D.E.A.R</p>	<p>SV Bhat Ch # 1</p>	<p>students will be able to:</p> <ul style="list-style-type: none"> ❖ understand the occurrence, chemical composition and biosynthesis of plant secondary metabolites ❖ identify natural products and their probable biosynthetic pathways; ❖ enhance their understanding of biological and biochemical sciences. ❖ follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an various classes of natural products biosynthesis or a determination of the structure of steroids.

9th	Mid Term Exam Weeek				
10 th	Alkaloids Classification, Separation Techniques Pharmaceutical Applications of Alkaloids	Lecture Presentation Group Discussion	Summative: Assignment # 3 Student Presentations	SV Bhat Ch # 4	students will be able to: ❖ follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an various classes of natural products biosynthesis or a determination of the structure of alkaloids ❖ draw structural and molecular formulas of natural products compound ❖ explain chemical structure, Isolation and purification methods, and general methods employed for determining the structure of alkaloids,
11 th	Biosynthesis of Alkaloids	Lecture Presentation Group Discussion Video clip	Summative: Quiz # 5 Student Presentations	SV Bhat Ch # 4	students will be able to: ❖ Understand biosynthesis of alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine, tryptophan, anthranilic acid, and histidine, Purine alkaloids. ❖ understand how biosynthetic pathways can be explored using labelled biosynthetic precursors. ❖ understand the impact of the natural products discussed on society and organic chemistry. ❖ apply the chemical principles highlighted by the study of these natural products to the synthesis of other unseen natural product structures. ❖ understand how to introduce nitrogen atom in a synthesis with diastereocontrol. ❖ appreciate the different strategies available for alkaloid natural product synthesis in the context of the synthesis of morphine and strychnine
12 th	Saponins Classification, Separation Techniques Pharmaceutical Applications	Lecture Presentation Group Discussion	Formative: 3-2-1 Summative: Quiz # 6 Student Presentations**	Ransheng Yang Ch # 3	students will be able to: ❖ know the different approaches that are used to discover new drug leads from nature ❖ understand the different methods that are used in natural products chemistry, including extraction, isolation, and structural elucidation ❖ understand the key biosynthetic pathways for the biosynthesis of polyketides, natural phenolics, terpenes, alkaloids, peptides and proteins

					<ul style="list-style-type: none"> ❖ recognize the most important building blocks employed in the biosynthesis of secondary metabolites
13 th	Prostaglandins Classification, Separation Techniques Pharmaceutical Applications	Lecture Presentation Group Discussion Video clip	Formative: Exit Slips Summative: Quiz # 7 Student Presentations	SV Bhat Ch # 3	students will be able to: <ul style="list-style-type: none"> ❖ analyze complicated natural product structures and transform them into simpler fragments ❖ recognize and be able to apply key biosynthetic reactions in order to predict how organisms make secondary metabolites ❖ review representative drug producing species ❖ review natural products use in contemporary medicine
14 th	Coumarins Classification, Separation Techniques Pharmaceutical Applications	Lecture Presentation Group Discussion Video clip	Summative: Quiz # 8 Student Presentations Submission Date of Case Study/Review Article	Ransheng Yang Ch # 11	students will be able to: <ul style="list-style-type: none"> ❖ use modern library search tools to locate and retrieve scientific information about a topic, organic chemical, chemical technique, or an issue relating to natural product chemistry. ❖ value the role of natural products in our life ❖ identify different types of natural products, their occurrence, structure, biosynthesis and properties. discuss the use of natural products as starting materials for medicines. carry out independent investigations of plant materials and natural products. ❖ acquire the knowledge about the role of coumarins in recent medicine, their physical and chemical characters. ❖ acquire the skill of handling and evaluation of natural products containing these compounds. ❖ skills of how to isolate, identify and quantify alkaloids and glycosides. ❖ to identify toxic plants and treat their toxicity.
15 th	Marine natural products, Physical Methods of characterization	Lecture Presentation Group Discussion Video clip	Summative: Quiz # 9 Student Presentations	SV Bhat Ch # 10	students will be able to: <ul style="list-style-type: none"> ❖ identify the bioactive compounds that derived from marine flora and fauna. ❖ acquire the skills necessary to critically examine a specific scientific problem and to be able to design and execute an adequate scientific research programe, collect data, interpret it and come with relevant conclusions. ❖ estimate the medicinally important marine natural

					products ❖ identify natural products obtained from marine sources and their pharmaceutical application.
16 th	Pharmacokinetics	Lecture Presentation Group Discussion	Formative: 3-2-1 Summative: Student Presentations	SV Bhat Ch # 11	students will be able to: ❖ define 'Pharmacokinetics' and 'Pharmacokinetic model' ❖ define the basic pharmacokinetic parameters of a drug including volume of distribution, clearance terms, extraction ratio, elimination half-life, unbound fraction and to understand how these parameters are related ❖ understand the role of compartment models in describing the time course of plasma/blood concentration of drugs in the body.4. To differentiate between organ clearance, total body clearance and formation clearance of a given metabolite and the fraction of clearance associated with a given enzyme ❖ understand the time course of drug accumulation in the body during a constant rate infusion and the notion of steady state (or plateau) level. ❖ understand the roles of transporters in drug absorption, distribution and elimination. ❖ learn the constituent present in crude drugs responsible for pharmacological activities
17 th	Student Presentations				
18 th	Final Exam				

** Student Presentation will be from assigned research Papers

1. Research Paper Rubric

Name: _____ Date: _____ Score: _____

Category	Exceeds Standard	Meets Standard	Nearly Meets Standard	Does Not Meet Standard	No Evidence	Score
Title Page	Title Your Name, Teacher's Name, Affiliation, Date, Neatly finished-no errors	Evidence of four	Evidence of 3	Evidence of 2 or less	Absent	
Statement	Clearly and concisely states the paper's purpose in a single sentence, which is engaging, and thought provoking.	Clearly states the paper's purpose in a single sentence.	States the paper's purpose in a single sentence.	Incomplete and/or unfocused.	Absent, no evidence	
Introduction	The introduction is engaging, states the main topic and previews the structure of the paper.	The introduction states the main topic and previews the structure of the paper.	The introduction states the main topic but does not adequately preview the structure of the paper.	There is no clear introduction or main topic and the structure of the paper is missing.	Absent, no evidence	
Body	Each paragraph has thoughtful supporting detail sentences that develop the main idea.	Each paragraph has sufficient supporting detail sentences that develop the main idea.	Each paragraph lacks supporting detail sentences.	Each paragraph fails to develop the main idea.	Not applicable	
Organization- Structural Development of the Idea	Writer demonstrates logical and subtle sequencing of ideas through well-developed paragraphs; transitions are used to enhance organization.	Paragraph development present but not perfected.	Logical organization; organization of ideas not fully developed.	No evidence of structure or organization.	Not applicable	
Conclusion	The conclusion is engaging and restates the thesis.	The conclusion restates the thesis.	The conclusion does not adequately restate the thesis.	Incomplete and/or unfocused.	Absent	
Mechanics	No errors in punctuation, capitalization and spelling.	Almost no errors in punctuation, capitalization and spelling.	Many errors in punctuation, capitalization and spelling.	Numerous and distracting errors in punctuation, capitalization and spelling.	Not applicable	
Usage	No errors sentence structure and word usage.	Almost no errors in sentence structure and word usage.	Many errors in sentence structure and word usage.	Numerous and distracting errors in sentence structure and word usage.	Not applicable	
Citation	All cited works, both text and visual, are done in the correct format with no errors.	Some cited works, both text and visual, are done in the correct format. Inconsistencies evident.	Few cited works, both text and visual, are done in the correct format.	Absent	Not applicable	
Bibliography	Done in the correct format with no errors. Includes more than 5 major references (e.g. science journal articles, books, but no more than two internet sites. Periodicals available on-line are not considered internet sites)	Done in the correct format with few errors. . Includes 5 major references (e.g. science journal articles, books, but no more than two internet sites. Periodicals available on-line are not considered internet).	Done in the correct format with some errors. Includes 4 major references (e.g. science journal articles, books, but no more than two internet sites. Periodicals available on-line are not considered internet).	Done in the correct format with many errors. Includes 3 major references (e.g. science journal articles, books, but no more than two internet sites. Periodicals available on-line are not considered internet sites.)	Absent or the only sites are internet sites.	

2. Oral Presentation:

Name: _____ Date: _____ Score: _____

Select the box which most describes student performance. Alternatively you can "split the indicators" by using the check boxes before each indicator to evaluate each item individually.

	Exceeds Standard	Meets Standard	Nearly Meets Standards	Does Not Meet Standard	Score
Language Use and Delivery The student communicates ideas effectively	<ul style="list-style-type: none"> ☞ Effectively uses eye contact. ☞ Speaks clearly, effectively and confidently using suitable volume and pace. ☞ Fully engages the audience. ☞ Dresses appropriately, ☞ Selects rich and varied words for context and uses correct grammar. 	<ul style="list-style-type: none"> ☞ Maintains eye contact. ☞ Speaks clearly and uses suitable volume and pace. ☞ Takes steps to engage the audience. ☞ Dresses appropriately. ☞ Selects words appropriate for context and uses correct grammar. 	<ul style="list-style-type: none"> ☞ Some eye contact, but not maintained. ☞ Speaks clearly and unclearly in different portions. ☞ Occasionally engages audience. ☞ Dresses inappropriately. ☞ Selects words inappropriate for context; uses incorrect grammar. 	<ul style="list-style-type: none"> ☞ Uses eye contact ineffectively. ☞ Fails to speak clearly and audibly and uses unsuitable pace. ☞ Does not engage audience. ☞ Dresses inappropriately. ☞ Selects words inappropriate for context; uses incorrect grammar. 	
Organization and Preparation The student exhibits logical organization.	<ul style="list-style-type: none"> ☞ Introduces the topic clearly and creatively. ☞ Maintains clear focus on the topic. ☞ Effectively includes smooth transitions to connect key points. ☞ Ends with logical, effective and relevant conclusion. 	<ul style="list-style-type: none"> ☞ Introduces the topic clearly. ☞ Maintains focus on the topic. ☞ Include transitions to connect key points. ☞ Ends with coherent conclusion based on evidence. 	<ul style="list-style-type: none"> ☞ Introduces the topic. ☞ Somewhat maintains focus on the topic. ☞ Includes some transitions to connect key points. ☞ Ends with a conclusion based on evidence. 	<ul style="list-style-type: none"> ☞ Does not clearly introduce the topic. ☞ Does not establish or maintain focus on the topic. ☞ Uses ineffective transitions that rarely connect points. ☞ Ends without a conclusion. 	
Content The student explains the process and findings of the project and the resulting learning.	<ul style="list-style-type: none"> ☞ Clearly defines the topic or thesis and its significance. ☞ Supports the thesis and key findings with an analysis of relevant and accurate evidence ☞ Provides evidence of extensive and valid research with multiple and varied sources ☞ Provides evidence of complex problem solving and learning stretch. ☞ Combines and evaluates existing ideas to form new insights. 	<ul style="list-style-type: none"> ☞ Clearly defines the topic or thesis. ☞ Supports the thesis and key findings with evidence. ☞ Presents evidence of valid research with multiple sources. ☞ Provides evidence of problem solving and learning stretch. ☞ Combines existing ideas to form new insights. 	<ul style="list-style-type: none"> ☞ Defines the topic or thesis. ☞ Supports the thesis with evidence. ☞ Presents evidence of research with sources. ☞ Provides some evidence of problem solving and learning stretch. ☞ Combines existing ideas. 	<ul style="list-style-type: none"> ☞ Does not clearly define the topic or thesis. ☞ Does not support the thesis with evidence. ☞ Presents little or no evidence of valid research. ☞ Shows little evidence of problem solving and learning stretch. ☞ Shows little evidence of the combination of ideas. 	
Questions and Answers	Demonstrates extensive knowledge of the topic by responding confidently, precisely and appropriately to all audience questions and feedback.	Demonstrates knowledge of the topic by responding accurately and appropriately to questions and feedback.	Demonstrates some knowledge of the topic by responding accurately and appropriately to questions and feedback.	Demonstrates incomplete knowledge of the topic by responding inaccurately and inappropriately to questions and feedback.	

3. Backboard of Presentation

Name: _____ Date: _____ Score: _____

	Exceeds Standard	Meets Standard	Nearly Meets Standard	Does Not Meet Standard	No Evidence	Score
Clarity of Topic	Includes a clear title which gives specific information about main topic.	Includes a title which gives information about the main topic.	Includes a title that gives some information about the main topic.	Missing a title or statement of the main topic.	Not present	
Details of Research	Includes all details from research and have clear labels, phrases, or sentence descriptions.	Includes most details from research and have clear labels or phrases.	Includes some details from research and have labels or phrases.	Includes only a few details from research using labels or phrases.	No details from research.	
Effectiveness	Viewer has a thorough understanding of topic researched. Backboard includes specific examples and/or illustrations in an organized manner.	Viewer has an understanding of the topic researched. Backboard includes examples and /or illustrations.	Viewer has some understanding of the topic researched. Backboard includes some examples and/or illustrations.	Viewer has difficulty understanding topic researched. Backboard includes few examples and/or illustrations.	Backboard does not communicate topic researched.	
Quality	Includes illustrations and labels. Content is edited for spelling and punctuation and has no errors.	Includes illustrations and labels. Content is edited for spelling and punctuation and has less than 3 errors.	Includes illustrations and labels. Content is not edited for spelling and punctuation and has more than 3 errors.	Does not include illustrations and labels and/or contains more than 3 errors in spelling and punctuation.	Work is haphazard and careless. Has none of the required elements.	