Section Three

OKLAHOMA UNIVERSITY
INSTITUTE OF TECHNOLOGY

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August 26, 2011

Oklahoma State Board of Education
Oliver Hodge Education Building
2500 N Lincoln Blvd
Oklahoma City OK 73105

To: Oklahoma State Board of Education

I am pleased to submit this letter of support on behalf of Oklahoma State University-Institute of Technology for the Focus Field of Study in Biomedical Sciences application submitted by Central Technology Center. I have been involved with Central Tech on several joint projects including the Tech Prep Consortium, The School to Work Consortium and the Cooperative Alliance Agreement. All of these joint agreements have been and continue to be successful.

Health care education is vital to the needs of the healthcare industry in northeastern Oklahoma. The Biomedical Sciences Academy will help to meet the demands of the health care industry for a highly-skilled workforce. High school students will have the opportunity to learn Principles of Biomedical Science, Medical Interventions, and Science Research in addition to taking high-level academic courses such as AP Calculus, AP Chemistry, AP Biology and Anatomy and Physiology. Students will be prepared to enter post-secondary education and major in a healthcare profession.

The unique geographic location of the Biomedical Sciences Academy at Central Tech allows students from seventeen high schools from a five county region of the state of Oklahoma to share resources for this advanced academic and technical academy. Each of the high schools benefit equally from the funding used for the academy and have access to upper level course work for students from vastly different geographic areas of the district. This type of cooperation and efficient use of funding helps to raise the academic bar for the state's high school graduates.

In closing, I fully support Central Tech in their pursuit of a Biomedical Sciences Academy. Thank you for your consideration of this Focus Field of Study Application.

Sincerely,

Linda Avant

Linda Avant, Ed.D.
Executive Vice-President
Academic Affairs

Biomedical Sciences
Central Technology Center
Advisor Committee Minutes for November 6, 2010

I. Call to order

Denise Radcliff called the meeting to order in the Biomedical Sciences classroom. The following members were present: Dr. Jared Bates, Meridian Technology Center; Tina Fugate, ODCTE; Karen Holmes, TCC; Dr. Diana Spencer, TCC, April Hutson, Mannford High School, Danielle Dunn, Student Representative, Denise Radcliff, Central Tech and LaDonna Gear, Central Tech.

II. Old Business

The minutes were approved as read.

III. New Business

a) *Curriculum Update*:
Two new PLTW courses and two new science courses were added to the student options this year. Medical Interventions and Biomedical Innovations are the second year courses from PLTW. In addition, AP Biology and Chemistry were added to the science options for students.

b) *Science Fair*:
The committee members suggested we consider a short (2-3 days) summer camp for 7th, 8th and 9th graders and if possible one for partner school instructors also. One topic they suggested we consider was forensics. Karen Holmes and Tina Fugate have examples of camps they have participated in before and will send their information to Mrs. Radcliff. Ms. Holmes is a member of the American Society of Clinical Lab Scientist and will see if materials and/or scholarships might be available from them.

c) *College Credit*
College credit is available for the PLTW classes at several universities. Dr. Diana Spencer and Karen Holms, both with TCC suggested we seek college credit for our Biomedical Sciences curriculum. Tina Fugate, ODCTE pointed out the only avenue now open to these students was through Advanced Placement credit. Currently the ODCTE does not plan to seek additional college credit.

d) Equipment Update
Ms. Holms and Dr. Spencer discussed the importance of exposing students to the spectrophotometer .

IV. Student Presentation

a) Danielle Dunn presented her outline for her senior project, *Fighting the Invasion of the Super Bug.*

V. **Discussion Question: What can Biomedical Sciences do to better prepare students for post-secondary biomedical and health program?**
Ms. Holmes emphasized how important it is for students to be able to apply mathematics skills. Her college students have difficulty understanding how to applying basic mathematics skills such as fractions and decimals.

VI. **Discussion Question: What should be added to our sequence of courses to better prepare students entering biomedical and health careers?** This question did not generate a great deal of discussion.

VII. **Discussion Question: What suggestions do you have to help us promote students entering our Biomedical Sciences career major?**
Summer camps

VIII. **Adjournment**

Drumright Municipal
Healthcare Authority
121 W. Broadway
3rd Floor
Drumright, Ok 74030
Trustees: Jim Martin-Chairman; Jamie Osterhout-Vice Chairman;
Ron Dyer; Danny Cooper; Don Temple; Randy Scott; Debra Bright

August 29, 2011

Oklahoma State Board of Education
Oliver Hodge Education Building
2500 N Lincoln Blvd
Oklahoma City OK 73105

To: Oklahoma State Board of Education

I would like to express the support of the Drumright Municipal Healthcare Authority for a much needed Biomedical Sciences Academy at Central Technology Center. There is a tremendous need for healthcare professionals not only in Drumright but throughout the Central Tech District. It is imperative that a highly-skilled workforce that can meet the needs for healthcare in northeastern Oklahoma be developed now and continue in the years to come. We support the concept of quality healthcare education in Oklahoma.

Central Technology Center has been a leader for our district in preparing individuals to work as Practical Nurses, Nursing Assistants, Surgical Technicians, Emergency Medical Technicians, Medical Assistants and Paramedics. The Biomedical Sciences Academy will take this effort to the next level. High school students will have the opportunity to learn Principles of Biomedical Science, Medical Interventions, and Science Research while taking high-level math and science courses such as AP Chemistry, Microbiology, AP Biology and AP Calculus. Students will be prepared for success at the post-secondary level as they continue their education in the health care field.

The Drumright Municipal Healthcare Authority is pleased to be a partner in this collaborative effort and we look forward to working with Central Technology Center in making the Biomedical Sciences Academy a success.

Thank you for your consideration of this Focused Field of Study Application.

Sincerely,

James W. Martin Jr.

Jim Martin, Chairman

Section Four

Career Tech Algebra 2 Objectives

Objective	OK C^3 Standards
Polynomial, Rational, and Radical Relationships	
Perform arithmetic operations with complex numbers.	N.CN.1, N.CN.2
Use complex numbers in polynomial identities and equations.	N.CN.7, N.CN.8(+), N.CN.9(+)
Interpret the structure of expressions.	A.SSE.1, A.SSE.2
Write expressions in equivalent forms to solve problems.	A.SSE.4
Perform arithmetic operations on polynomials.	
Understand the relationship between zeros and factors of polynomials.	A.APR.2, A.APR.3
Trigonometric Funtions	
Extend the domain of trigonometric functions using the unit circle.	F.TF.1, F.TF.2
Model periodic phenomena with trigonometric functions.	F.TF.5
Prove and apply trigonometric identities.	F.TF.8
Modeling with Functions	
Create equations that describe numbers or relationships.	A.CED.1, A.CED.2, A.CED.3, A.CED.4
Interpret functions that arise in applications in terms of a context.	F.IF.4, F.IF.5, F.IF.6
Inferences and Conclusions from Data	
Summarize, represent, and interpret data on a single count or measurement variable.	S.ID.4

Understand and evaluate random processes underlying statistical experiments.	S.IC.1, S.IC.2
Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	S.IC.3, S.IC.4, S.IC.5, S.IC.6
Inferences and Conclusions from Data Continued	
Use probability to evaluate outcomes of decisions.	S.MD.6(+), S.MD.7(+)

Central Technology Center
Algebra II
Alignment of Course Content with Oklahoma C³ Standards

The following list of educational objectives for Central Technology Centers' Algebra II course has been aligned with the National Science Education Standards and the Oklahoma *C³* Standards. It also follows the Oklahoma Department of CareerTech Standard to be considered for high school Algebra II academic credit. Central Technology Centers' highly qualified instructors provide rigorous and relevant curriculum to enable students to succeed in current and future academic endeavors.

Objective	National Council of Teachers of Mathematics 9-12 Standards	Oklahoma Algebra II C³ Standards
Equations and Inequalities		
• Use a number line to graph and order real numbers and identify properties of and use operations with real numbers.	Numbers & Operations Algebra Measurement	**Content** 1.3a, 1.3b, 3.2a, 3.2b, 3.2c, 3.2d **Process** 1.1, 1.2, 2.1, 5.1, 5.2, 5.3
• Evaluate and simplify algebraic expressions in order to solve linear equations.	Numbers & Operations Algebra Measurement	**Content** 1.3a, 1.3b, 3.2a, 3.2b, 3.2c, 3.2d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.2, 5.1
• Rewrite equations with more than one variable, including formulas, to set up and solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 1.3a, 1.3b, 3.1a, 3.1b, 3.1c, 3.2a, 3.2b, 3.2c, 3.2d, 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1
• Use a five-step method for problem solving along with drawing a model or searching for a pattern.	Numbers & Operations Algebra Measurement	**Content** 1.3a, 1.3b, 3.1a, 3.1b, 3.1c, 3.2a, 3.2b, 3.2c, 3.2d, 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1

• Solve compound inequalities.	Numbers & Operations Algebra Measurement	**Content** 2.1a, 2.2a, 2.2b 2.2c, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.2, 5.1
• Solve absolute value equations and inequalities.	Numbers & Operations Algebra Measurement	**Content** 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.2, 5.1
• Use absolute value equations and inequalities to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.2b, 2.7a 2.7b, 2.7c, 2.7d, 3.1a, 3.1b, 3.1c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
Linear Equations and Functions		
• Identify and represent relations and functions.	Numbers & Operations Algebra	**Content** 1.3a, 1.3b, 2.1a, 2.1b, 2.1c, 2.1d, 2.1e, 2.2a, 2.2b, 2.2c, 2.5a, 2.5b, 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.2, 5.1
• Graph and evaluate linear functions.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Find the slope of a line and identify parallel and perpendicular lines from their slopes in order to understand slope as a rate of change.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1

• Graph linear equations using both slope-intercept and standard forms in order to identify and graph horizontal and vertical lines	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2
• Write direct variation equations.	Numbers & Operations Algebra	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Explore positive and negative correlation using scatter plots and best-fitting lines.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Represent piecewise functions.	Numbers & Operations Algebra Measurement	**Content** 1.2b, 2.1b, 2.1c, 2.1d, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use piecewise functions to model real-life quantities.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 3.2a, 3.2b, 3.1c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Represent absolute value functions.	Numbers & Operations Algebra Measurement	**Content** 2.1b, 2.1c, 2.1d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use absolute value functions to model real-life situations.	Numbers & Operations Algebra Measurement	**Content** 3.2a, 3.2b, 3.2c, 3.2d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

Systems of Linear Equations and Inequalities		
• Solve systems of two linear equations in two variables algebraically and by graphing.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.1b, 2.1c, 2.1d, 2.2a, 2.2b, 2,2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Graph a system of linear inequalities to find the solutions of the system.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.1b, 2.1c, 2.1d, 2.2a, 2.2b, 2,2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2
• Use systems of linear inequalities to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 2.1b, 2.1c, 2.1d, 2.1e, 2.2a, 2.2b, **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Use linear programming to solve real-life optimization problems.	Numbers & Operations Algebra Measurement	**Content** 2.1b, 2.1c, 2.1d, 2.1e, 2.2a, 2.2b, 2,2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Graph and solve algebraically linear equations in three variables and consider the related functions of two variables using real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.1b, 2.1c, 2.1d, 2.2a, 2.2b, 2,2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3

Matrices and Determinants		
• Add and subtract matrices, multiply a matrix by a scalar, and solve matrix equations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1
• Use matrices to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Multiply two matrices.	Numbers & Operations Algebra	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use matrix multiplications in real-life situations.	Numbers & Operations Algebra Measurement	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Evaluate determinants of 2X2 and 3X3 matrices.	Numbers & Operations Algebra	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use Cramer's rule to solve systems of linear equations.	Numbers & Operations Algebra Measurement	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Find and use inverse matrices.	Numbers & Operations Algebra	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use inverse matrices in real-life situations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

• Solve systems of linear equations using inverse matrices.	Numbers & Operations Algebra	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 5.1
• Use systems of linear equations to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
Quadratic Equations		
• Graph quadratic functions.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1
• Use quadratic functions to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.3a, 2.3c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Factor quadratic expressions and solve quadratic equations by factoring.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Find zeros of quadratic functions.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Solve quadratic equations by finding square roots.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1

• Use quadratic equations to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 2.3a, 2.3b, 2.3c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Solve quadratic equations with complex solutions and perform operations with complex numbers.	Numbers & Operations Algebra	**Content** 1.3a, 1.3b, 2.3a, 2.3b, 2.3c, 2.4 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Apply complex numbers to fractal geometry.	Numbers & Operations Algebra Measurement	**Content** 1.3a, 1.3b, 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1
• Solve quadratic equations by completing the square.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use completing the square to write quadratic functions in vertex form.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1
• Solve quadratic equations using the quadratic formula.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use the quadratic formula in real-life situations.	Numbers & Operations Algebra Measurement	**Content** 2.1b, 2.1c, 2.1d, 2.3a, 2.3b, 2.3c, 2.4 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

• Graph quadratic inequalities in two variables.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Solve quadratic inequalities in one variable.	Numbers & Operations Algebra	**Content** 2.3a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
Polynomials and Polynomial Functions		
• Use properties of exponents to evaluate and simplify expressions involving powers.	Numbers & Operations Algebra Measurement	**Content** 1.1a, 1.1b, 2.6a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Evaluate a polynomial function.	Numbers & Operations Algebra Measurement	**Content** 1.2a, 2.6a, 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Graph a polynomial function.	Numbers & Operations Algebra	**Content** 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Use polynomial operations in real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.2a, 2.6a, 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Factor polynomial expressions.	Numbers & Operations Algebra	**Content** 2.6a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1

• Use factoring to solve polynomial equations.	Numbers & Operations Algebra Measurement	**Content** 2.6a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Divide polynomials and relate the result to the remainder theorem and the factor theorem.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.2a, 2.6a, 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use polynomial division in real life problems.	Numbers & Operations Algebra Measurement	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Find the rational zeros of a polynomial function.	Numbers & Operations Algebra	**Content** 1.2a, 2.6a, 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2.2, 3.3, 3.4, 5.1
• Use polynomial equations to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 1.2a, 2.6a, 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Use the fundamental theorem of algebra to determine the number of zeros of a polynomial function.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.6a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use technology to approximate the real zeros of a polynomial function.	Numbers & Operations Algebra	**Content** 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3

• Analyze the graph of a polynomial function.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2
• Use the graph of a polynomial function to answer questions about real-life situations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.6b, 2.6c, 2.6d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
Powers, Roots, and Radicals		
• Evaluate nth roots of real numbers using both radical notation and rational exponent notation.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.1a, 1.1b, 2.5 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use nth roots to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.1a, 1.1b, 2.5a, 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Use properties of rational exponents to evaluate and simplify expressions.	Numbers & Operations Algebra Measurement	**Content** 1.1a, 1.1b, 1.2b **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use properties of rational exponents to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.1a, 1.1b, 2.5c, 2.7a, 2.7b, 2.7c, 2.7d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

• Perform operations with functions including power functions.	Numbers & Operations Algebra	**Content** 1.3a, 1.3b, 2.1b, 2.1c, 2.1d, 2.2a, 2.2b, 2.2c, 2.3a, 2.5c, 2.6b, 2.6c, 2.6d, 2.7a, 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use power functions and function operations to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 1.3a, 1.3b, 2.1b, 2.1c, 2.1d, 2.2a, 2.2b, 2.2c, 2.3a, 2.5c, 2.6b, 2.6c, 2.6d, 2.7a, 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Find inverses of linear functions.	Numbers & Operations Algebra	**Content** 2.1e, 2.2a, 2.2b, 2.2c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Find inverses of nonlinear functions.	Numbers & Operations Algebra	**Content** 1.2a, 2.1e, 2.5a, 2.6a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Solve equations that contain radicals or rational exponents.	Numbers & Operations Algebra	**Content** 1.1a, 1.1b, 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Use radical equations to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 1.1a, 1.1b, 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1

• Use measures of central tendency and measures of dispersion to describe data sets.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 3.2a, 3.2b, 3.2c, 3.2d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2
Exponential and Logarithmic Functions		
• Graph exponential growth functions.	Numbers & Operations Algebra Measurement	**Content** 2.5a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3
• Use exponential growth functions.	Numbers & Operations Algebra Measurement	**Content** 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3
• Graph exponential decay functions.	Numbers & Operations Algebra Measurement	**Content** 2.5a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3
• Use exponential decay functions to model real-life situations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Use the number "e" as the base of exponential functions.	Numbers & Operations Algebra Measurement	**Content** 2.5b **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use the natural base "e" in real-life situations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

• Evaluate logarithmic functions.	Numbers & Operations Algebra	**Content** 2.5a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1
• Use properties of logarithmic functions.	Numbers & Operations Algebra	**Content** 2.5b **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Use properties of logarithms to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.5c **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Solve exponential equations.	Numbers & Operations Algebra	**Content** 2.5a, 2.5b **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Model data with exponential functions.	Numbers & Operations Algebra Measurement	**Content** 2.5a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Model data with power functions.	Numbers & Operations Algebra Measurement	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
Rational Equations and Functions		
• Write and use inverse variation models.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2

• Write and use joint variation models.	Numbers & Operations Algebra Measurement	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2
• Graph simple rational functions.	Numbers & Operations Algebra	**Content** 2.7b, 2.7c, 2.7d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3
• Use the graph of a rational function to solve real-life problems.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Content** 2.7a, 2.7b, 2.7c, 2.7d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Graph general rational functions.	Numbers & Operations Algebra	**Content** 2.7b, 2.7c, 2.7d **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3
• Multiply and divide rational expressions.	Numbers & Operations Algebra	**Content** 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3
• Use rational expressions to model real-life quantities.	Numbers & Operations Algebra Measurement	**Content** 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Add and subtract rational expressions.	Numbers & Operations Algebra	**Content** 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Simplify complex fractions.	Numbers & Operations Algebra	**Content** 1.2b **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1, 5.2, 5.3

• Solve rational equations.	Numbers & Operations Algebra	**Content** 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use rational equations to solve real-life problems.	Numbers & Operations Algebra Measurement	**Content** 1.2b, 2.7a **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
Sequences and Series		
• Use and write sequences.	Numbers & Operations Algebra Measurement	**Content** 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
• Use summation notation to write series and find sums of series.	Numbers & Operations Algebra Measurement	**Content** 3.3 **Process** 1.1, 1.2, 2.1, 2.2, 2.3, 5.1
Probability and Statistics		
• Use the binomial theorem to expand a binomial that is raised to a power.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
• Find the probabilities of unions and intersections of two events.	Numbers & Operations Algebra Measurement Data Analysis & Probability	**Process** 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3

Central Technology Center
Chemistry
Alignment of Course Content with PASS

The following list of educational objectives for Central Technology Centers' Chemistry course has been aligned with the National Science Education Standards and the Oklahoma *Priority Academic Student Skills* (PASS) Process Standards. It also follows the Oklahoma Department of CareerTech Standard to be considered for high school Chemistry lab science academic credit. Central Technology Centers' highly qualified instructors provide rigorous and relevant curriculum to enable students to succeed in current and future academic endeavors.

Objective	National Science Education Standards 9-12 Content Standards	Oklahoma Chemistry Content and Process PASS Standards
Laboratory Techniques		
• Display appropriate and safe chemistry classroom and laboratory behavior	A	
• Display proper equipment handling for laboratory use	A	
Matter and Measurements		
• Define matter, elements, atoms, and compounds	A, B	**Content** 1.1, 1.2, 1.3, 1.4
• Distinguish between chemical and physical properties	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Describe matter by its chemical and physical properties	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the standard units for length, mass, time, and temperature	A	
• Explain the Scientific method and be able to use when presented real-world situations	A	
• Be able to use significant figures appropriately in scientific calculations	A	
• Be able to use scientific	A, B	
notation in scientific calculations		
• Compare and contrast precision and accuracy	A, B	**Content** 1.1, 1.2, 1.3

Atoms and Periodic Table		
• Explain the Atomic Theory and have an understanding of its history	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the functional structure of the Periodic Table	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Define mole and explain how it is used in chemistry	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Be able to calculate molar mass	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Understand and explain the characteristic properties of families of elements	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
Molecules and Compounds		
• Be able to name and write formulas	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Determine empirical formula of a compound from its mass percent composition	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the role of a valence electron in an ion	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Be able to describe an ion and how it will react with other elements	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
Chemical Reactions and Stoichiometry		
• Write and balance chemical equations	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.4
• Explain mass-mole relationships	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Identify and define the types of chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1
• Define and determine limiting reactants	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2
• Define and determine percent yield	A, B	**Content** 1.1, 1.2, 1.3, 1.4,

		1.5, 2.1, 2.2
Aqueous Solutions and Reactions		
• Define and explain the differences of the three types of aqueous reactions (acid-base, precipitations, gas-forming, oxidation-reduction)	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2
• Describe net ionic equations	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain how to prepare molar solutions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Apply the pH scale to calculate the concentration of hydronium ions and hydroxide ions given the pH of a solution	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Describe how an acid base titration is formed	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
Gases		
• Define the Gas Laws (Boyles Law, Charles Law, Combined Gas Law, Ideal Gas Law, Dalton's Law) and be able to use mathematically.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4
• Define diffusion and effusion and be able to calculate the rates	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4
Energy and Chemical Reaction		
• Describe the affect of temperature on chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.4
• Explain specific heat and have knowledge of how it can be measured	A, B	Content 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain enthalpy and how it can be used with Hess's Law	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Distinguish between heat and temperature		**Content** 1.1, 1.2, 1.3, 1.4,

		1.5, 2.1, 2.2, 2.3, 2.4
• Understand what is meant by caloric content in foods	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 5.3
Atomic Structure		
• Explain the Quantum Mechanical Model	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain energy levels and orbitals of atomic structures and be able to diagram	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Understand Bohr's Model and explain how its been modernized	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain electron configuration and be able to do electron dot configuration	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Describe trends in the Periodic Table and be able to predict an element's reactivity	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
Molecular Structure		
• Define and explain Lewis structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain Ionic and covalent bonding and be able to determine how elements will combine	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain electronegativity and explain its effects on chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Define and explain Resonance structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Define and explain VSEPR structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4

Labs/Activities		
Laboratory techniques Students will: • Use the scientific method to solve real-life problems presented in case study form. • Organize information to facilitate analysis of your data • Draw graphs that present data clearly and accurately • Interpret data in tables, charts, and graphs • Draw conclusions that are supported by experimental data • Analyze data using common statistical measures • Apply your knowledge of the scientific method to real-life situations	A	**Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4
Accuracy and precision Students will: • Experience differences between precision and accuracy • Formulate hypotheses about precision, accuracy, and probability • Calculate probability for experimental experiences • Discuss the outcome of the experiment	A, B	**Content** 1.1, 1.2, 1.3 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.7, 6.2, 6.3, 6.4
Separation of mixtures Students will: • Determine type of mixture • Conduct an investigation to separate a homogenous mixture • Discuss the outcome of the experiment • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Flame tests Students will: • Conduct an investigation to view	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4

the different colors of flames emitted by the different solutions • Chart the color emitted by the different elements and identify like colors • Discuss the outcome of the experiment • Write a detailed lab report citing all steps taken in the scientific method.		**Process** 1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4
Percent composition of hydrates Students will: • Conduct an experiment to determine the number of moles of water associated with one mole of copper sulfate in the hydrate • Write the correct formula for the hydrate • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Polymers Students will: • Prepare a condensation polymer • Discuss common polymer they encounter in everyday life • Conduct an experiment to cross-link a polymer and observe the changes in the physical properties as a result of this cross-linking. The changes in physical properties of a cross-linked polymer are also studied as the temperature is varied. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 5.3, 6.1, 6.2, 6.3, 6.4
Stoichiometry and Gravimetric Analysis Students will: • Recall chemical symbols as part of chemical equations • Convert word equations to chemical formulas	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1,

• Apply correct chemical nomenclature • Conduct an experiment to determine the mass of an element by isolating it in a solid compound of known identity and definite composition. • Write a detailed lab report citing all steps taken in the scientific method.		3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 5.1, 5.2, 6.1, 6.2, 6.3, 6.4
Stoichiometry of reactions Students will: • Apply the concept of stoichiometric coefficient relating to reaction ratios • Balance equations • Discuss the reasons for balancing equations • Calculate empirical formulas from percentage by mass data • Conduct an experiment testing computations of percent yield with actual lab results. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Calorimetry and Hess's Law Students will: • Calculate the heat of formation of magnesium oxide using Hess's law • Assuming the heat capacity of the HCl is the same as that of water, calculate the amount of heat liberated when the magnesium reacted • Assuming the heat capacity of the acid is the same as that of water, conduct an experiment in order to calculate the amount of heat liberated when the MgO reacted	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4

Calorimetry and molarity Students will: • Calculate the number of moles (n) of sulfuric acid (volume in Liters Calculate the number of moles (n) of sulfuric acid (volume in Liters times molarity in mol/l) in mol/l) • Conduct an experiment to find the molar enthalpy of the fusion of ice.(melting of ice) • Calculate the total volume of the two solutions (both sulfuric acid and sodium hydroxide) • Calculate the mass of the two solutions combined • Calculate the molar enthalpy of sulfuric acid	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Boiling point elevation and molar mass Students will: • Determine the change in boiling point from the observed boiling point of the solution and the boiling point of the pure solvent • Determine the molar concentration, m, from the change in boiling point and the boiling point elevation constant • Determine the moles of unknown (the solute) from the molality of the solution and the mass of solvent (in kilograms) used to make the solution • Determine the molar mass from the mass of the unknown and the number of moles of unknown	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Equilibrium and expressions Students will: • Observe and describe some reactions, which are easily reversible, and some, which are not easily reversible. • Consider the implications for a system when the rates of the forward and the reverse reactions that define the system are equal.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 5.1, 5.3, 6.1, 6.2,

• Discuss non-chemical analogies, which illustrate or simulate equilibria. • Distinguish between dynamic equilibria and steady-state processes. • Discuss the influence of free energy on the spontaneity of reactions. • Understand why Le Chatelier's principle works. • Use Le Chatelier's principle to predict how various equilibrium systems will shift in response to external stress and then conduct a series of experiments altering, first the temperature in a stable chemical reaction and then the concentration effects. • Write a detailed lab report citing all steps taken in the scientific method. • Discuss industrial applications of Le Chatelier's principle.		6.3, 6.4
Acid-base titration Students will: • Perform an acid-base titration to determine the concentration of an acid solution • Use the results to calculate the unknown concentration of an acid or a base • Given data from three or more titrations, students should be able to identify the strongest concentration of unknown	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 5.2, 6.1, 6.2, 6.3, 6.4
Buffering (Acid-base) Students will: • Compare an unbuffered solution with a buffered solution by using the technique of titration • Interpret explanations of the effects of buffers • Collect data and record figures • Graph data and figures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4

• Write a detailed lab report citing all steps taken in the scientific method.		
Reaction rate Students will: • Determine the rate of reaction at a given point in time • Determine the stoichiometric coefficients for a chemical reaction • Explore variables that affect reaction rate by experimentation. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Redox titration Students will: • Find the % hydrogen peroxide in a commercially sold solution • Find the % iron in an unknown iron salt • Write the balanced net ionic equation for the reaction • Identify the oxidizing and reducing agents • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4

Central Technology Center
Pre-Calculus
Alignment of Course Content with Oklahoma C³ Standards

The following list of educational objectives for Central Technology Centers' Pre-Calculus course has been aligned with the National Science Education Standards and the Oklahoma *C³* Standards. It also follows the Oklahoma Department of CareerTech Standard to be considered for high school Pre-Calculus academic credit. Central Technology Centers' highly qualified instructors provide rigorous and relevant curriculum to enable students to succeed in current and future academic endeavors.

Objective	NCTM Standard	Oklahoma C³ Standard
I. Quadratic Formula		
A. Review knowledge of irrational numbers	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
B. Review knowledge of imaginary numbers	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
C. Extend and apply the definitions of remainder, factor, and rational root theories	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
D. Absolute values: Quadratic Equations	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
E. Absolute values: Inequalities	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
F. Apply polynomial inequalities	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
G. Be able to work with rational inequalities	Number & Operations Algebra	1.1, 2.1, 2.2, 2.3, 5.3
H. Extend and apply the definitions of domain, range, and graphical analysis of	Number & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.1,3.2, 3.4, 4.3, 4.4, 5.1,5.2, 5.3

rational functions		
II. Periodic Functions and Right Triangle Problems		
A. Find and graph the function that corresponds to a graph	Number & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 5.3
B. Given an angle of any measure, draw a picture of the angle	Number & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 5.3
C. Extend the definitions of sine and cosine for any angle	Number & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.2, 3.4, 5.3
D. Using a calculator, find values of the six trigonometric functions for any angle	Number & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 5.3
E. Given two sides of a right triangle or a side and an acute angle-find measures of the other sides and angles	Number & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 5.3
III. Functions and Mathematical Models		
A. Be able to work with functions that are defined algebraically, graphically, numerically, or verbally	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 5.3
B. Make connections among the algebraic equation for a function, its name, and its graph	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 4.1, 5.3
C. Transform a given pre-image functions so that the result is a graph of the image function that has been dilated by given factors and translated by given amounts	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 5.3
D. Given two	Numbers & Operations	1.1, 2.1, 2.2, 2.3, 3.3,

functions—graph and evaluate the composition of one function with the other	Algebra Measurement	3.4, 5.3
E. Given a function—find its inverse relation and tell whether or not the inverse relation is a function	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
F. Given a function—transform it by reflection and by applying absolute value to the function or its argument	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
G. Piecewise functions	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
H. Difference Quotient	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
VI. Applications of Trigonometric and Circular Functions		
A. Know the meanings of amplitude, period, phase displacement, and cycle of a sinusoidal graph	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 5.3
B. Given any one of these sets of information about a sinusoid, find the other two: the equation; the graph; the amplitude, period or frequency, phase displacement, and sinusoidal axis	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
C. Plot the graphs of the tangent, cotangent, secant, and cosecant functions—showing their behavior when the function value is	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3

undefined		
D. Given an angle measure in degrees, convert it to radians and be able to convert from radians to degrees	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
E. Given an angle measured in radians- find the trigonometric function values	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
F. Be knowledgeable about the circular functions and their relationship to trigonometric functions	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
G. Given the equation a circular or trigonometric function and a value of y, find specified values of x or 0—Graphically, Numerically, or Algebraically	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
H. Given a verbal description of a periodic phenomenon, write an equation using sine or cosine functions and use the equation as a mathematical model to make predictions and interpretations about the real world	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.1, 3.2, 3.4, 4.3, 4.4, 5.1, 5.2, 5.3
V. Trigonometric Function Properties, Identities, and Parametric Functions		
A. Investigate the sum of the squares of the cosine and sine of the same argument	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Derive algebraically	Numbers & Operations	1.1, 2.1, 2.2, 2.3, 3.3,

three kinds of properties expressing relationships among trigonometric functions	Algebra Measurement	3.4, 5.3
C. Given a trigonometric expression—transform it to an equivalent form that is perhaps simpler or more useful	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
D. Find algebraically or numerically the solutions for equations involving circular or trigonometric sines, cosines, and tangents of one argument	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
E. Given equations of a parametric function—plot the graph and make conclusions about the geometrical figure that results	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
F. Plot graphs of inverse trigonometric functions and relations	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
G. Find exact values of functions of inverse trigonometric functions	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
VI. Properties of Combined Sinusoids		
A. Investigate graphs formed by sums of sines and cosines	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Derive a composite argument property expressing cos(A-B) in terms of cosines and sines of A and B, and use it to express a linear combination of cosine and sine as a	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3

single cosine with a phase displacement		
C. For trigonometric functions f-derive and learn properties for: f(-x) in terms of f(x), f(90°-0) in terms of functions of 0 or f(-x) in terms of functions of x, f(A=B) and f(A-B) in terms of functions of A and B	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
D. Given two sinusoids-form a new graph by adding or multiplying ordinates (y-coordinates)	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
E. Given a graph formed by adding or multiplying two sinusoids-find the equations of the two sinusoids	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
F. Transform a sum of two sinusoids to a product and then the reverse	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
G. Prove that a product of sinusoids with equal periods is also a sinusoid	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
H. Derive properties for cos 2A, sin 2A, and tan 2A in terms of functions of A	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
I. Derive properties for cos ½ A, sin ½ A, and tan ½ A in terms of functions of A	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
VII. Triangle Trigonometry		
A. Given two sides	Numbers & Operations	1.1, 2.1, 2.2, 2.3, 3.3,

and the included angle of a triangle-find the remaining side by direct measurement	Algebra Measurement	3.4, 5.1, 5.2, 5.3
B. Given two sides and the included angle of a triangle-derive and use the law of cosines to find the remaining side	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
C. Given three sides of a triangle-find an angle	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
D. Given the measures of two sides and the included angle-find the area of the triangle	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
E. Given the measure of an angle, the length of the side opposite this angle, and one other piece of information about the triangle-find the other side and angle measures	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
F. Given two sides of a triangle and a non-included angle-calculate the value of the third side	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
G. Given two vectors-add them to find the resultant	Numbers & Operations Algebra Measurement	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
H. Given a real-world problem-identify a triangle and use the appropriate technique to calculate unknown side lengths and angle measures	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.1, 3.2, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3
VIII. Properties of Elementary Functions		
A. Review exponents;	Numbers & Operations	1.1, 2.1, 2.2, 2.3, 3.3,

laws of exponents	Algebra	3.4, 5.3
B. Review radicals: laws of radicals	Numbers & Operations Algebra	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
C. Discover patterns in linear, quadratic, power, and exponential function graphs	Numbers & Operations Algebra	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
D. Given the graph of a function, know whether the function is exponential, power, quadratic, or linear and find the particular equation algebraically	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
E. Given a set of regularly spaced x-values and the corresponding y-values, identify which type of function they fit (linear, quadratic, power, or exponential)	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
F. Find other function values without finding the particular equation. Learn the definition and properties of logarithms, and use logarithms to find algebraic solutions of exponential and logarithmic equations.	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
G. Show that logarithmic functions have the multiply-add property, and find particular equations by algebra	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
H. Fit a logistic function to data for restrained growth	Numbers & Operations Algebra Measurement Data Analysis &	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3

	Probability	
IX. Matrix Transformations and Fractal Figures		
A. Explore what happens to the perimeter and area of a square when the same set of transformations are performed repeatedly	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Given two matrices-find the sum and product	Numbers & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
C. Given a square matrix-find its multiplicative inverse	Numbers & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
D. Solve a system of linear equations algebraically, graphically, and using matrices	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
X. Analytic Geometry of Conic Sections and Quadric Surfaces		
A. Given a quadratic equation with two variables, plot its graph and formulate conclusions	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
B. Given a Cartesian or parametric equation of a conic section, sketch or plot the graph and find the equation	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
C. Given the equation of a conic section, sketch the surface generated by rotating it about one of its axes	Numbers & Operations Algebra Measurement Geometry Data Analysis &	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3

and find the area or volume of a figure inscribed either in the plane region bounded by the graph or in the solid region bounded by the surface	Probability	
D. Given the equation of a conic section-find the foci, the directrix, and the eccentricity. Be able to do the reverse	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
E. Given a situation from the real world in which conic sections appear-create a mathematical model and use it to make predictions and interpretations	Numbers & Operations Algebra Measurement Geometry Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
XI. Polar Coordinates, Complex Numbers, and Moving Objects		
A. Given an equation in polar coordinates, plot the graph on polar coordinate paper	Numbers & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Given a polar equation-plot the graph	Numbers & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
C. Given the polar equation of a conic section-transform it to Cartesian coordinates	Numbers & Operations Algebra Geometry	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
XII. Sequences and Series		
A. Given a few terms in a sequence or series of numbers-find more terms	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Given a series-find the sum of a specified	Numbers & Operations Algebra	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3

number of terms	Measurement Data Analysis & Probability	
C. Use sigma notation to write partial sums	Numbers & Operations Algebra Measurement Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
XIII. Polynomial and Rational Functions Limits and Derivatives		
A. Review rational equations	Numbers & Operations Algebra	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
B. Discover some properties of cubic functions and their graphs	Numbers & Operations Algebra	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.3
C. Given a polynomial function: Use a graph to interpret the degrees & the reverse Find the zeros from the equation or graph	Numbers & Operations Algebra Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
D. Given a set of points-find the equation of a polynomial function that fits the data exactly or fits the best for a given degree	Numbers & Operations Algebra Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
E. Find and identify discontinuities in the graphs of rational functions	Numbers & Operations Algebra Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3
F. Given an equation of a polynomial function-find the instantaneous rate of change at a given point and interpret the answer graphically	Numbers & Operations Algebra Data Analysis & Probability	1.1, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2, 5.3

Central Technology Center
Microbiology
Alignment of Course Content with Oklahoma PASS Standards

The following list of educational objectives for Central Technology Centers' Microbiology course has been aligned with the National Science Education Standards and the Oklahoma *PASS Standards*. It also follows the Oklahoma Department of CareerTech Standard to be considered for high school microbiology lab science academic credit. Central Technology Centers' highly qualified instructors provide rigorous and relevant curriculum to enable students to succeed in current and future academic endeavors.

Objective	National Science Education Standards 9-12 Content Standards	Oklahoma PASS Standards
I. History of Microbiology		
A. Explain the importance of observations made by Robert Hooke and Anton van Leeuwenhoek	A, C, F, G	
B. Compare and contrast the contributions of Needham, Spallanzani, Virchow, and Pasteur	A, C, F, G	
C. Understand and be able to explain the connection between spoilage of food and microorganisms as a major step toward establishing the relationship between disease and microbes	A, C, F, G	
D. Explain how Pasteur's work influenced Lister and Koch.	A, C, F, G	
E. Explain how Edward Jenner altered preventative health care.	A, C, F, G	
F. Evaluate the contributions to microbiology made by Ehrlich and Fleming.	A, C, F, G	

Relationship of Microbes and Human Welfare		
• Be able to discuss several beneficial activities of microorganisms	A, C, E, F, G	
• Explain how viruses are used in gene therapy	A, C, E, F, G	
Human Microbial Diseases		
• Identify several emerging infectious diseases and explain why they are emerging	A, C, E, F, G	
• Analyze resistance and all factors that lead to it	A, C, F, G	
• Evaluate and explain normal human flora	A, C, F, G	
Microscopy		
• Have a working understanding of the metric units used in microscopy that are used for microorganisms	A	
• Explain the path of light through a compound microscope	A, E	
• Calculate total magnification and resolution	A, E	
• Identify a use for darkfield, phase-contrast, differential interference contrast, fluorescence, confocal, and scanning acoustic microscopy, and compare each with brightfield illumination.	A, C, E	
• Explain how a scanning electron microscope works and how it benefits microbiology	A, C, E	

• Describe the appearance of gram-positive and gram-negative cells after each step of preparing a Gram stain	A, C, E	
• Compare and contrast the Gram stain and the acid-fast stain	A, C, E	
• Be able to analyze and identify special stains in order to isolate specific parts of microorganisms	A, C, E	
Functional Anatomy of Microorganisms		
• Compare and contrast the overall cell structure of prokaryotes and eukaryotes	A, C	
• Discuss evidence that supports the endosymbiotic theory of eukaryotic evolution	A, C, F, G	
• Differentiate between eukaryote and prokaryote organelles	A, C	
• Apply knowledge of the functions of the organelles in order to explain how microorganisms are able to survive	A, F	
Microbial Metabolism		
• Understand the two types of metabolism and be able to discuss how energy is transferred in both	B, C	

• Describe the mechanism of enzymatic action	C	
• Explain all factors that affect enzymatic activity and why they are catalysts	C	
• Describe and explain how feedback inhibition is used to control functions in the human body	A, C	
• Explain what is meant by oxidation-reduction	C	
• List and provide examples of three types of phosphorylation reactions that generate ATP	C	
• Understand and explain the products of cellular respiration and how this process affects the body as a whole	C	
• Know the alternate pathways bacteria use instead of glycolysis	C	
• Discuss the differences between aerobic and anaerobic respiration	C	
• Describe the chemical reactions and products of fermentation	C	
• Discuss biochemical tests to identify bacteria in the laboratory		

• Compare and contrast cyclic and noncyclic photophosphorylation	C	
• Compare and contrast the light-dependent and light-independent reaction of photosynthesis	C	
• Categorize the various nutritional patterns among organisms according to carbon source and mechanisms of carbohydrate catabolism and ATP generation	A, C	
• Describe the major types of anabolism and their relationship to catabolism	C	
• Understand where amphibolic pathways are used and why	A, C	
Microbial Growth		
• Classify microbes according to preferred temperature range	A, C	
• Identify how and why the pH of culture media is controlled	A, C	
• Explain the importance of osmotic pressure to microbial growth	A, C	
• Identify ways in which aerobes avoid damage by toxic forms of oxygen	A, C	

• Explain how microbes are classified on the basis of oxygen requirements	A, C	
• Know the use of the elements needed in large amounts for microbial growth	A, C	
• Justify the use of each of the following: anaerobic techniques, living host cells, candle jars, selective and differential media, enrichment medium	A, C	
• Have an understanding of the different types of medium and when each is used	A, C	
• Describe how pure cultures can be isolated by using the streak plate method	A, C	
• Explain how microorganisms are preserved by deep-freezing and lyophilization	A, C	
• Understand the two ways bacteria divide and how generation time can be calculated	A, C, F	
• Compare the phases of microbial growth, and describe their relation to generation time	A, C, F	
• Explain the direct methods of measuring cell growth	A, C, F	
• Differentiate between direct and indirect methods of measuring cell growth	A, C	

Control of Microbial Growth		
• Have a basic understanding of factors that control microbial growth	A, C	
• Describe the patterns of microbial death caused by treatments with microbial control agents	A, C	
• Compare the effectiveness of moist heat and dry heat on microbial control	A, C	
• Describe how filtration, low temperatures, high pressure, desiccation, and osmotic pressure suppress microbial growth	A, C	
• Describe radiation effects on cells	A, C	
• Interpret the results of use-dilution tests and the disk-diffusion method	A, C	
• Identify and differentiate between the types of disinfectants	A, C	
• Identify the method of sterilizing plastic labware	A, C	
• Explain how the control of microbial control is affected by the type of microbe	A, C	
Microbial Genetics		
• Understand and be able to describe the DNA molecule	A, C	

• Describe the process of DNA replication	A, C	
• Describe protein synthesis, including transcription, RNA processing, and translation	A, C	
• Explain the regulation of gene expression in bacteria by induction, repression, and catabolite repression	A, C	
• Classify mutations and describe how they are prevented or repaired	A, C	
• Understand what a mutagen is and its frequency rate	A, C	
• Explain how an Ames test is used	A, C	
• Compare the mechanisms of genetic recombination in bacteria	A, C	
• Describe the function of plasmids and transposons	A, C	
Recombinant DNA Technology and Biotechnology		
• Explain the importance of recombinant DNA technology	A, C, E, F	
• Identify the roles of a clone and a vector in making recombinant DNA	A, C, E, F	
• Discuss artificial selection and how it affects populations	A, C, E, F	

• Have a working knowledge of restriction enzymes and how they are used to make recombinant DNA	A, C, E, F	
• Describe the use of plasmid and viral vectors	A, C, E, F	
• Know the PCR technique and provide examples of its use	A, C, E, F	
• Explain and understand several techniques of getting DNA into a cell	A, C, E, F	
• Be able to select the best method of selecting recombinant bacteria	A, C, E, F	
• Explain several applications of rDNA technology	A, C, E, F	
• Have a working knowledge of Bioinformatics and be able to use this in the analysis of DNA sequences	A, C, E, F	
• Diagram the Southern blotting procedure and give examples of its use	A, C, E, F	
• Discuss DNA fingerprinting as a diagnostic tool	A, C, E, F	
• Discuss the aspects of genetically modified plants and identify the complex social issues that connected to this area of microbiology	A, C, E, F	

Nomenclature of Microorganisms		
• Differentiate among eukaryotic, prokaryotic, and viral species	C	
• Use the biological classification system to classify organisms	A, C	
• Distinguish between the different kingdoms of multicellular Eukarya	C	
• Describe how staining and biochemical tests are used to identify bacteria	A, C, E	
• Differentiate between Western and Southern blotting	A, C, E	
• Explain how serological tests and phage typing can be used to identify an unknown bacterium	A, C, E	
• Use PCR, DNA fingerprinting, or DNA base composition to classify and describe a newly discovered microbe	A, C, E	
• Identify microorganisms by nucleic acid hybridization, Southern blotting, DNA chips, ribotyping, and FISH	A, C, E	
Epidemiology		
• Discuss the different aspects of the study of Pathology	A, C, E, F, G	

• Compare and contrast between normal and transient microbes	C	
• Compare and contrast commensalisms, mutualism, and parasitism and give examples of each	C, F	
• Be able to use Koch's postulates to discuss the framework for etiology of infectious disease	A, C, E	
• Distinguish between communicable and noncommunicable diseases and categorize according to frequency of occurrence	C	
• Identify several predisposing factors for disease	C	
• Using previous knowledge, describe and discuss the stages of disease	C	
• Compare the different modes of disease transmission	C	
• Explain what nosocomial infections are and how they are transmitted.	C, E, F	
• Have an understanding of emerging diseases and their causes and be able to discuss the reason for their evolution	C, E, F, G	

• Know the different types of epidemiology and understand the importance of case reporting	C, E, F, G	
Pathogenicity		
• Be able to identify all portals of entry of the human body for pathogens and predict physiologically what enables entry	A, C	
• Understand virulence and how it is reported and measured	C	
• Have an understanding of how bacterial pathogens penetrate host defenses and be able to discuss the effects on a molecular as well as an organelle level	C	
• Analyze the damage done by pathogens to host cells and the direct damage done to the cell	C	
• Be able to predict the viral mechanism that was used for evasion of a host and the effects on the host	C	
• Distinguish between pathogenic properties of fungi, protozoa, heminths, and algae	C	

Immunology-Adaptive and Innate		
• Evaluate the different areas of the first line of defense and be able to identify the normal microbiota and innate immunity	C	
• Distinguish between second line of defense mechanisms (phagocytes, blood, inflammation, fever) when assessing an infection	C	
• Evaluate the different kinds of antimicrobial substances available	A, C, E, F	
• Differentiate between innate and adaptive immunity	C	
• Explain the relationship between antigens and antibodies as a response of the immune system and discuss the four outcomes of an antigen-antibody reaction	C	
• Discuss the specificity of the human body concerning the production of antibodies	C	
• Evaluate the different types of T cells and other forms of cellular immunity and discuss their different functions	C	

• Compare and contrast the different kinds of cytokines	C	
• Make inferences on the types of adaptive immunity	A, C	
Applications of Immunology		
• Analyze how, physiologically, a vaccine is effective and discuss how they are used worldwide	A, C, E, F	
• Distinguish between types of vaccines and describe how they use new technology and knowledge to be advantageous	A, C, E, F	
• Evaluate from a historical as well as modern day perspective the development of new vaccines	A, C, E, F, G	
• Evaluate the different types of diagnostic tests that are available and classify them for sensitivity and specificity	A, C, E	
• Differentiate between the direct and indirect ELISA test	A, C, E	
Antimicrobial Drugs		
• Analyze which microbes are used to produce antibiotics and explain why	A, C, E, F	

• Classify antimicrobial drugs according to their mode of action	A, C, E	
• Discuss how anti-fungal, viral, protozoan, and helminthic drugs are used and analyze their effectiveness	A, C, E	
• Predict the effectiveness of chemotherapeutic agents by using knowledge of current drug resistance and antibiotic safety concerns	A, C, E, F	
Environmental Microbiology		
• Analyze how microorganisms contribute to the earth's structure and function enabling survival of life	A, C, D, E, F, G	
• Evaluate the importance of microorganisms in the soil and the role they play in the biogeochemical cycles	A, C, D, F	
• Predict what effects on microbial life that domestic and industrial wastewater will have on lakes and streams given specific case studies	A, C, D, F	

• Discuss and explain how marine aquatic microorganisms are an integral part of that ecosystem	A, C, D, F	
• Evaluate from a public health perspective the role microbes play in water quality, both freshwater treatment and wastewater	A, C, D, F	
• Predict the diseases that would occur if water quality was compromised	A, C, D, E, F, G	
Food Microbiology		
• Analyze how microbial control, either by support or suppression of growth, has changed the way humans live and survive	A, C, E, F,	
• Classify the different kinds of food preservation methods according to the types of spoilage (i.e., organisms controlled, types of food used on, etc.)	C, E	
• Discuss, explain, and give examples of the beneficial activities performed by microorganisms on food production	C, E, F	

• Synthesize a method to maximize the life cycle of yeast in order to make fermentation more efficient	A, C, E, F	
Industrial Microbiology		
• Analyze how, on a large-scale commercially, products such as antibiotics, vaccines, enzymes, and hormones, can be manufactured by microbes	C, E, F	
• Evaluate the different microbes and their functions in industrial chemicals and pharmaceuticals	A, C, E, F	
• Discuss and explain the method used to convert biomass into an alternative fuel source	C, E, F	
• Evaluate and present current methods and initiatives to produce alternate fuel sources	C, E, F	
• Predict future use of microorganisms in industry	C, E, F	
Laboratory Safety and Infection Control		
• Distinguish between disinfection and sterile conditions and give examples of both methods of achievement	A, C, E, F	

• Evaluate sterile techniques when handling microorganisms	A, C, E, F	
• Explain and demonstrate the technique for developing a pure culture	A, C, E, F	
• Decide which bacteria, fungi, parasite, or protist is present in a culture by performing diagnostic tests using the necessary techniques needed for handling and culturing these disease agents	A, C, E, F	
• Utilize the MSDS book provided in the laboratory to develop a chemical safety plan	A, C, E, F	
• Using case studies, analyze laboratory safety procedures	A, C, E, F	
• Evaluate and explain the method used in the laboratory for biological waste disposal	A, C, E, F	
Suggested Labs/Activity Topics		
Laboratory Safety	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4

Microscope Use	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Preparation of Specimens	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Staining Bacteria	A, C, E, F	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Cultivation of Bacteria and Fungi	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Microscopic Observation of Bacteria, Fungi, and Protozoa	A, C, E, F	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Soil and Water Microbiology	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5,

		4.6, 4.7, 4.8, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4
Biochemical Tests for the Identification of Bacteria	A, C, E, F	1.1, 1.2, 1.3, 2.1,2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Fermentation Labs	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Evaluating Antibacterial Chemical Agents	A, C, E, F	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Microbial Pathogens	A, C, E, F	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4
Parasitology	A, C, E, F	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.4

Responses to Infection	A, C, E, F	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3,4.4, 4.5, 4.6, 4.7, 4.8, 5.3, 6.1, 6.2, 6.3, 6.

Resources

Standards

National Science Standards (5th ed). (1998). National Research Council, Washington, D.C., National Academy of Sciences

Oklahoma Priority Academic Student Skills (2003). Oklahoma State Department of Education-PASS-{ www.sde.state.ok.us}