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| **Framework Title: Ag Science-Biology** |
| **CIP Code:** 261201 | **Total Framework Hours up to: 180**  |
| **Course: AgScience-Biology** |  **Exploratory Preparatory**  |
| **Career Cluster: AFNR Cluster Pathway: AB Date Last Modified: 11/12/10** |
| **Pathway Content Standard:** The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture. |
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| **Performance Assessments** |
| *SAE.01. This course will include instruction in and Student involvement in Supervised Agriculture Experience Projects (SAE).* |
| ***STANDARDS AND PERFORMANCE INDICATORS*** |
| **Performance Indicator: SAE.01.01. The Students will establish and conduct Supervised Agriculture Experience Projects (SAE) as an integral part of an Agriculture Education program.. This information is taught at the beginning of the course. Total Learning Hours: 5 to 10 hours**  |
| **Level I=Basic Level II=Core Level III=Advanced**  | Standards |
| **Level I, II, III** |  **Performance Indicators** |  |
| SAE.01.01.a. | Explain the history of SAE. |  |
| SAE.01.01.b. | Explain the benefits of SAE projects to skill development, leadership and career success. |  |
| SAE.01.01.c. | Explain the connection between SAE and FFA. |  |
| **SAE.01.01.d.** | Explain the five types of SAE. (Entrepreneurship, Placement, Research, Exploratory, Improvement) |  |
| SAE.01.01.e. | Explore ideas for SAE projects. |  |
| SAE.01.01.f. | Explain how SAE projects support academic achievement. |  |
| SAE.01.01.g. | Select and establish an SAE project. |
| SAE.01.01.h. | Explain and keep records on established SAE projects. |
| SAE.01.01.i. | Explain SAE project Supervision, visitation and assessment. |
| SAE.01.01.j. | Explain how SAE projects benefit the community. |
| SAE.01.01.k. | Seek recognition for SAE project accomplishments. |
| SAE.01.01.l. | Explain the three circle concept for SAE, FFA Leadership, Classroom/Laboratory in an Agriculture Education program. |

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| **Performance Element Assessed:** |
| **Recognize the historical, social, cultural and potential applications of biotechnology.** |
| ***PERFORMANCE INDICATOR(S)*** |
| **Performance Indicator(s):** Distinguish major innovators, historicaldevelopments and potential applications of biotechnology in agriculture.Science: E2, F6 and G3 Language Arts: 8 Social Studies: 2b, 8a, 8c and 8e **Total Learning Hours:**  |
|  **Number Performance: Level I=Basic Level II=Core Level III=Advanced**  | Standard #  |
| **BS.01.01.01.a.** | Biotechnology and explore the historical impact it has had on agriculture.Level I | Science: E2, F6 and G3 |
| **BS.01.01.02.a.** | Investigate current applications of biotechnology in agriculture. Level I | Language Arts: 8 |
| **BS.01.01.03.a.** | Examine potential future applications of biotechnology in agriculture and compare them with alternative approaches to improving agriculture. Level I | Social Studies: 2b, 8a, 8c and 8e |
| **BS.01.01.01.b.** | Create a timeline and use it to explain the developmental progression of biotechnology. Level II |  |
| **BS.01.01.02.b.** | Research and report on current work being done in agricultural biotechnology. Level II |  |
| **BS.01.01.03.b.** | Research and report on emerging problems and issues associated with agricultural biotechnology. Level II |  |
| **BS.01.01.01.c.** | Research and report on the major innovators and milestones in the development of biotechnology. Level III |  |
| **BS.01.01.02.c.** | Analyze the scope and impact of agricultural biotechnology in today’s global society. Level III |  |
| **BS.01.01.03.c.** | Assess the future impact agricultural biotechnology could have on world populations. Level III |  |
| ***PERFORMANCE INDICATOR(S)*** Determine regulatory issues and identify agencies associated with biotechnology. |
| **Performance Indicator(s):** Determine regulatory issues and identifyagencies associated with biotechnology.Science: A1 Language Arts: 4 and 7 Social Studies: 10c **Total Learning Hours:**  |
|  **Number Performance: Level I=Basic Level II=Core Level III=Advanced**  | Standard #  |
| **BS.01.02.01.a.** | Describe the role of agencies that regulate biotechnology. Level I | Science: A1 |
| **BS.01.02.01.b.** |  Interpret the major regulatory issues related to biotechnology. Level II | Language Arts: 4 and 7Social Studies: 10c |
| **BS.01.02.01.c.** | Research, evaluate and articulate a major regulatory issue pertaining to biotechnology. Level III |  |
| ***PERFORMANCE INDICATOR(S)*** Analyze the ethical, legal, social and cultural issues relating to biotechnology. |
| **Performance Indicator(s):** Analyze the ethical, legal, social and cultural issues relating to biotechnology. Science: A4 Language Arts: 4, 7 and 8Social Studies: 10c and 10i **Total Learning Hours:**  |
|  **Number Performance: Level I=Basic Level II=Core Level III=Advanced**  | Standard #  |
| **BS.01.03.01.a.** | Explore ethical, legal and social biotechnology issues. Level I | Science: A4 |
| **BS.01.03.02.a.** | Explore the emergence, evolution and implications of bioethics. Level I | Language Arts: 4, 7 and 8 |
| **BS.01.03.03.a.** |  Explain the meaning of intellectual properties as related to biotechnology. Level I | Social Studies: 10c and 10i |
| **BS.01.03.01.b.** |  Evaluate the benefits and risks associated with biotechnology. Level II |  |
| **BS.01.03.02.b.** |  Examine an ethical dilemma associated with biotechnology by identifying its components. Level II |  |
| **BS.01.03.03.b.** |  Examine intellectual properties associated with biotechnology by defining their components. Level II  |  |
| **BS.01.03.01.c.** |  Research, evaluate and articulate the implications of an ethical, legal, social or cultural biotechnology issue. Level III |  |
| **BS.01.03.02.c.** | Research and debate an ethical issue associated with biotechnology. Level III |
| **BS.01.03.03.c.** |  Analyze an intellectual property issue associated with bioethics. Level III |  |
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| **Social Studies - Civics** |
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| **Writing** |
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| **Art** |
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| **Science Standards** |
|  | 9-12SYSA, 9-12 SYSB, 9-12 SYSC, 9-12APPA, 9-12APPE, 9-12APPF, 9-11LS1E, 9-11LS2E, 9-11LS2F, 9-11LS3A,9-11LS3B,9-11LS3C |
| **Mathematics Standards** |
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| ***SKILLS*** |
| **Leadership: Students participate in activities such a Public Speaking, Extemporaneous Speaking and Agricultural Issues**  |
| **Employability: 1.2.A, 1.2.B, 1.2.C, 1.2.D, 1.3.A,1.5.A, 1.5.B** |
| **Analytical, Logical & Creative Thinking (check those that students will demonstrate in this lesson):** |
| x[ ]  Observe[ ]  Patternsx[ ]  Sequence[ ]  Classifyx[ ]  Compare/Contrast[ ]  Predict | x[ ]  Cause/Effect[ ]  Fact/Opinionx[ ]  Main Ideax[ ]  Summary[ ]  Point of View[ ]  Analysis | [ ]  Finding Evidencex[ ]  Evaluationx[ ]  Detect Bias[ ]  Inferencex[ ]  Conclusion[ ]  Metacognition | x[ ]  Reasoning[ ]  Problem Solving[ ]  Goal Settingx[ ]  Fluency[ ]  Elaborationx[ ]  Flexibility | [ ]  Originality [ ]  Riskingx[ ]  Inquisitiveness[ ]  Attending[ ]  Persistence[ ]  Precision |
| **Relevance to Work:** Understanding that a strong work ethic will contribute to higher productivity in organizations. |

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| **Performance Assessments** |
| **Demonstrate laboratory skills as applied to biotechnology.** |
| ***STANDARDS AND PERFORMANCE INDICATORS*** |
| **Performance Indicator: Total Learning Hours:** **BS.02.01.** Maintain and interpret biotechnology laboratory records. Math: 2D, 3A and 5B Science: A2 and A6Language Arts: 5 and 7 |
| **Level II=Core Level III=Advanced**  |
|  | **Performance Indicator Description** | Standards  |
| **BS.02.01.01.a.** | Maintain a biotechnology laboratory notebook. Level I | Math: 2D, 3A and 5B |
| **BS.02.02.01.a.** | Operate basic laboratory equipment and measurement devices. Level I |  |
| **BS.02.01.01.b.** | Analyze strengths of the research based on data and procedures, and propose future investigation. Level II | Science: A2 and A6 |
| **BS.02.02.01.b.** | Operate advanced laboratory equipment and measurement devices. Level II | Language Arts: 5 and 7 |
| **BS.02.01.01.c.** | Utilize external reviews and compare them to research conducted. Level III |  |
| **BS.02.02.01.c.** | Calibrate laboratory equipment and conduct instrument qualification tests. Level III |  |
| ***STANDARDS AND PERFORMANCE INDICATORS*** |
| **Performance Indicator: Total Learning Hours:** **BS.02.03.:** Demonstrate proper laboratory procedures using biological materials. Science: A2, A3 and E1 |
| **BS.02.03.01.a.** | Demonstrate basic aseptic techniques in the biotechnology laboratory. Level I | Science: A2, A3 and E1 |
| **BS.02.03.02.a.** | Perform procedures with biological materials according to directions. Level I |  |
| **BS.02.03.01.b.** | Demonstrate advanced aseptic techniques in the biotechnology laboratory. Level II |  |
| **BS.02.03.02.b.** | Select an appropriate standard operating procedure for working with biological materials. Level II |  |
| **BS.02.03.01.c.** | Perform bioassays and experiments under aseptic conditions. Level III |  |
| **BS.02.03.02.c.** | Develop a standard operating procedure for a biological process. Level III |  |
| ***STANDARDS AND PERFORMANCE INDICATORS*** |
| ***Performance Indicator: Total Learning Hours:*** **BS.02.04.** Safely manage biological materials, chemicals and wastes used in the laboratory. |
| **BS.02.04.01.a.** | Prepare simple chemical solutions using standard operating procedures. Level I |  |
| **BS.02.04.02.a.** | Identify and describe hazards associated with biological and chemical materials. Level I |  |
| **BS.02.04.03.a.** | Maintain a safe environment by properly identifying and disposing of laboratory waste. Level I |  |
| **BS.02.04.01.b.** | Prepare buffers, reagents, solutions and media. Level II |  |
| **BS.02.04.02.b.** | Inventory biological and chemical materials, and maintain accurate records of supplies and expiration dates. Level II |  |
| **BS.02.04.03.b.** | Diagram the flow of waste after it leaves the laboratory. Level II |  |
| **BS.02.04.01.c.** | Verify the physical properties of buffers, reagents, solutions and media. Level III |  |
| **BS.02.04.02.c.** | Order, stock and maintain supplies of biological and chemical materials. Level III |  |
| **BS.02.04.03.c.** | Devise a management plan to reduce laboratory waste. Level III |  |
| ***STANDARDS AND PERFORMANCE INDICATORS*** |
| ***Performance Indicator: Total Learning Hours:*** **BS.02.05.** Perform microbiology, molecular biology, enzymology and immunology procedures. Math: 2C Science: A1, A2, A3, B2, C2, C6 and E2Language Arts: 4 |
| **BS.02.05.01.a.** | Differentiate the types of organisms and demonstrate how to handle them safely. Level I | Math: 2C |
| **BS.02.05.02.a.** | Explain the structures of DNA and RNA and how genotype influences phenotype. Level I | Science: A1, A2, A3, B2, C2, C6 and E2 |
| **BS.02.05.03.a.** | Extract and purify DNA and RNA. Level I | Language Arts: 4 |
| **BS.02.05.04.a.** | Perform simple enzyme activity assays to detect proteins. Level I |  |
| **BS.02.05.05.a.** | Describe how antibodies are formed and how they can be used in biotechnology applications. Level I |  |
| **BS.02.05.06.a.** | Explain reasons for detecting microbes and identify sources of microbes. Level I |  |
| **BS.02.05.01.b.** | Isolate, maintain, quantify and store cell cultures. Level II |  |
| **BS.02.05.02.b.** | Explain the molecular basis for heredity and the tools and techniques used in DNA and RNA manipulations. Level II |  |
| **BS.02.05.03.b.** | Perform electrophoretic techniques and interpret electrophoresis fragmentation patterns. Level II |  |
| **BS.02.05.04.b.** | Perform protein separation techniques and interpret the results. Level II |  |
| **BS.02.05.05.b.** | Conduct an Enzyme-Linked Immunosorbent Assay (ELISA). Level II |  |
| **BS.02.05.06.b.** | Research and describe the use of biotechnology to detect microbes. Level II |  |
| **BS.02.05.01.c.** | Characterize the physical, chemical and biological properties of microbes. Level III |  |
| **BS.02.05.02.c.** | Analyze factors that influence gene expression. Level III |  |
| **BS.02.05.03.c.** | Perform DNA and RNA manipulations, such as cloning/subcloning, blotting, sequencing and amplification. Level III |  |
| **BS.02.05.04.c.** | Characterize the biochemical properties of proteins. Level III |  |
| **BS.02.05.05.c.** | Use antibodies to detect and quantify antigens. Level III |  |
| **BS.02.05.06.c.** | Design and perform an assay to detect a target microorganism in food, water or the environment. Level III |  |

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| ***EALRs, GLEs, Math and Science Standards (Taught & Assessed in Standards)*** ***(Samples included below of GLEs, EALRS, Math and Science Standards must be modified for district frameworks)*** |
| **Reading** |
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| **Communications** |
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| **Social Studies – Civics** |
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| **Writing** |
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| **Art** |
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| **Science Standards** |
|  | 9-12SYSA, 9-12SYSB, 9-12SYSC, 9-12INQA, 9-12INQB, 9-12INQE,9-12APPA, 9-12APPB, 9-12APPE, 9-12APPF,  |
| **Mathematics Standards** |
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| ***SKILLS*** |
| **Leadership: Students participate in activities such a Public Speaking, Extemporaneous Speaking, Agricultural Issues and Wreath Project**  |
| **Employability: 1.2.A, 1.2.B, 1.2.C, 1.2.D, 1.3.A,1.5.A, 1.5.B** |
| **Analytical, Logical & Creative Thinking (check those that students will demonstrate in this lesson):** |
| x[ ]  Observex[ ]  Patternsx[ ]  Sequencex[ ]  Classifyx[ ]  Compare/Contrast[ ]  Predict | x[ ]  Cause/Effectx[ ]  Fact/Opinionx[ ]  Main Ideax[ ]  Summary[ ]  Point of View[ ]  Analysis | [ ]  Finding Evidencex[ ]  Evaluation[ ]  Detect Bias[ ]  Inference[ ]  Conclusion[ ]  Metacognition | x[ ]  Reasoningx[ ]  Problem Solvingx[ ]  Goal Setting[ ]  Fluency[ ]  Elaboration[ ]  Flexibility | [ ]  Originality x[ ]  Riskingx[ ]  Inquisitiveness[ ]  Attendingx[ ]  Persistence[ ]  Precision |
| **Relevance to Work:** Understanding that a strong work ethic will contribute to higher productivity in organizations. |

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| **Performance Element Assessed:** |
| **BS.03. Demonstrate the application of biotechnology to Agriculture,****Food and Natural Resources (AFNR).** |
| ***PERFORMANCE INDICATOR(S)*** |
| **Performance Indicator(s): BS.03.01** Evaluate the application of genetic engineeringto improve products of AFNR systems.Math: 2C Science: A2, C2, En2 and F4 Language Arts: 7 and 8 **Total Learning Hours:**  |
|  **Number Performance: Level I=Basic Level II=Core Level III=Advanced**  | Standard #  |
| **BS.03.01.01.a.** | Explain biological, social, agronomic and economic reasons for genetic modification of eukaryotes.Level I | Math: 2C |
| **BS.03.01.02.a.** | Describe enzymes, the changes they cause in foods and the physical and chemical parameters that affect enzymatic reactions. Level I | Science: A2, C2, En2 and F4 |
| **BS.03.01.03.a** | Compare and contrast the use of natural organisms and genetically engineered organisms in the treatment of wastes. Level I | Language Arts: 7 and 8 |
| **BS.03.01.04.a.** | Describe the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of aquatic species. Level I |  |
| **BS.03.01.01.b** | Diagram the processes and describe the techniques used to produce transgenic eukaryotes. Level II |  |
| **BS.03.01.02.b.** | Describe processes by which enzymes are produced through biotechnology. Level II |  |
| **BS.03.01.03.b.** | Diagram the process by which organisms are genetically engineered for waste treatment. Level II |  |
| **BS.03.01.04.b.** | Investigate and report on genetic engineering procedures used in the production of aquatic species. Level II |  |
| **BS.03.01.01.c.** | Design and conduct an experiment to evaluate an existing transgenic eukaryote. Level III |  |
| **BS.03.01.02.c.** | Use biotechnology tools or microbial strain selection to improve or discover enzymes for use in food processing. Level III |  |
| **BS.03.01.03.c.** | Monitor and evaluate the treatment of a waste product using a genetically engineered organism. Level III |  |
| **BS.03.01.04.c.** | Conduct field or clinical trials for genetically modified aquatic species. Level III |  |
| ***PERFORMANCE INDICATOR(S)*** |
| **Performance Indicator(s):** Perform biotechnology processes used in AFNR systems. Science: B3, C5, D1 and E2 Language Arts: 4**Total Learning Hours** |
| **BS.03.02.01.a.** | Explain the functions of hormones in animals. Level I | Science: B3, C5, D1 and E2 |
| **BS.03.02.02.a.** | Identify foods produced through fermentation**.** Level I | E2 Language Arts: 4 |
| **BS.03.02.03.a.** | Explain the process of fermentation. Level I |  |
| **BS.03.02.04.a.** | Explain the process of transesterification. Level I |  |
| **BS.03.02.05.a.** | Explain the process of methanogenesis. Level I |  |
| **BS.03.02.01.b.** | Describe the processes used to produce animal hormones from transgenic organisms. Level II |  |
| **BS.03.02.02.b** | Compare and contrast bioengineering and conventional pathways used in food processing. Level II |  |
| **BS.03.02.03.b.** | Describe the process used in producing alcohol from biomass. Level II |  |
| **BS.03.02.04.b.** | Diagram the process used in producing biodiesel from biomass. Level II |  |
| **BS.03.02.05.b.** | Illustrate the process used in producing methane from biomass. Level II |  |
| **BS.03.02.01.c.** | Administer hormones to enhance animal health, growth or reproduction, and monitor and analyze the results. Level III |  |
| **BS.03.02.02.c.** | Process food using biotechnology. Level III |  |
| **BS.03.02.03.c.** | Produce alcohol and co-products from biomass. Level III |  |
| **BS.03.02.04.c.** | Produce biodiesel and co-products from biomass. Level III |  |
| **BS.03.02.05.c.** | Produce methane and co-products from biomass. Level III |  |
| ***PERFORMANCE INDICATOR(S)*** |
| **Performance Indicator(s):** Use biotechnology to monitor and evaluate procedures performed in AFNR systems. Science A2,A3,C4,C6 andF5 Language Arts: 7 and 8**Total Learning Hours** |
| **BS.03.03.01.a** | Describe the selective plant breeding process. Level I | Science A2,A3,C4,C6 andF5 |
| **BS.03.03.02.a.** | Describe biotechnology processes applicable to animal health. Level I | Language Arts: 7 and 8 |
| **BS.03.03.03.a.** | Give examples of instances in which bioremediation can be applied to clean up environmental contaminants Level I |  |
| **BS.03.03.04.a.** | Explain the use of microorganisms in biological waste management. Level I |  |
| **BS.03.03.05.a.** | Explain the role of microorganisms in industrial chemical waste treatment. Level I |  |
| **BS.03.03.06.a.** | Explain the global importance of biodiversity. Level I |  |
| **BS.03.03.07.a.** | Explain the consequences of agricultural practices on wild populations. Level I |  |
| **BS.03.03.08.a.** | Explain biomass and sources of biomass. Level I |  |
| **BS.03.03.09.a.** | Define industrial biotechnology, and describe the benefits and risks associated with its use in the manufacturing of fabrics, plastics and other products. Level I |  |
| **BS.03.03.01.b** | Select biotechnology tools used to monitor and direct plant breeding. Level II |  |
| **BS.03.03.02.b.** | Assess the benefits, risks and opportunities associated with using biotechnology to promote animal health. Level II |  |
| **BS.03.03.03.b.** | Describe the use of biotechnology in bioremediation. Level II |  |
| **BS.03.03.04.b.** | Describe the processes involved in bio-treatment of biological wastes. Level II |  |
| **BS.03.03.05.b.** | Interpret the processes involved in bio-treatment of industrial chemical wastes. Level II |  |
| **BS.03.03.06.b.** | Select biotechnology tools used to measure biodiversity. Level II |  |
| **BS.03.03.07.b.** | Explain how biotechnology tools can be used to monitor the effects of agricultural practices on wild populations. Level II |  |
| **BS.03.03.08.b** | Assess the characteristics of biomass that make it useful for bio-fuels production. Level II |  |
| **BS.03.03.09.b** | Describe the processes used in the production of molecules for use in industrial applications. Level II |  |
| **BS.03.03.01.c.** | Design and conduct an experiment using biotechnology tools to evaluate selectively bred plants. Level III |  |
| **BS.03.03.02.c.** | Design animal-care protocols that use biotechnology tools to ethically monitor and promote animal systems. Level III |  |
| **BS.03.03.03.c.** | Monitor and evaluate the effectiveness of bioremediation efforts by participating in a bioremediation project. Level III |  |
| **BS.03.03.04.c.** | Monitor and evaluate the treatment of biological wastes with microorganisms. Level III |  |
| **BS.03.03.05.c.** | Monitor and evaluate the treatment of industrial chemical wastes with microorganisms. Level III |  |
| **BS.03.03.06.c.** | Use biotechnology tools to measure biodiversity in a population. Level III |  |
| **BS.03.03.07.c.** | Analyze the implications of biotechnology on wild species**.** Level III |  |
| **BS.03.03.08.c.** | Evaluate the technologies used to create bio-fuels from biomass. Level III |  |
| **BS.03.03.09.c.** | Monitor and evaluate biotechnology processes used in the synthesis of a molecule. Level III |  |
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| **Social Studies - Civics** |
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| **Writing** |
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| **Art** |
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| **Science Standards** |
|  | 9-12SYSA, 9-12SYSB, 9-12SYSC,9-12SYSD, 9-12INQA, 9-12INQB, 9-12INQC,9-12INQE, 9-11 ES3A, 9-11ES3C, 9-11LS1A, 9-11LS1B,9-11LS1C, 9-11LS1D, 9-11LS1E, 9-11 LS1F, 9-11LS1H, 9-11LS1I, 9-11LS2A,, 9-11LS2B,9-11LS2C9-11LS2E,9-11LS2F, 9-11LS3E |
| **Mathematics Standards** |
|  |  |
| ***SKILLS*** |
| **Leadership: Students participate in activities such as Public Speaking, Extemporaneous Speaking, Agricultural Issues, Food Science, Wreath project and Plant Sale** |
| **Employability: 1.2.A, 1.2.B, 1.2.C, 1.2.D, 1.3.A,1.5.A, 1.5.B** |
| **Analytical, Logical & Creative Thinking (check those that students will demonstrate in this lesson):** |
| x[ ]  Observex[ ]  Patternsx[ ]  Sequence[ ]  Classifyx[ ]  Compare/Contrast[ ]  Predict | x[ ]  Cause/Effect[ ]  Fact/Opinionx[ ]  Main Ideax[ ]  Summary[ ]  Point of View[ ]  Analysis | [ ]  Finding Evidencex[ ]  Evaluationx[ ]  Detect Bias[ ]  Inferencex[ ]  Conclusion[ ]  Metacognition | x[ ]  Reasoningx[ ]  Problem Solvingx[ ]  Goal Settingx[ ]  Fluency[ ]  Elaboration[ ]  Flexibility | [ ]  Originality x[ ]  Riskingx[ ]  Inquisitiveness[ ]  Attendingx[ ]  Persistence[ ]  Precision |
| **Relevance to Work:** Understanding that a strong work ethic will contribute to higher productivity in organizations. |