

**Course Title: Plant Biotechnology**

<b>Unit: 1</b>	<b>Career Opportunities</b>
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<b>Content Standard(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <ol style="list-style-type: none"> <li>Identify career opportunities associated with plant biotechnology.                      Examples: environmental chemist, genetic engineer, plant breeder, plant physiologist</li> </ol>
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<b>Learning Objective(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <ol style="list-style-type: none"> <li>Identify career and entrepreneurship opportunities and expectations.</li> </ol>
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<b>Essential Question(s):</b>	What are some career opportunities associated with plant biotechnology?
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<b>Content Knowledge</b>	<b>Suggested Instructional Activities Rigor &amp; Relevance Framework (Quadrant)</b>	<b>Suggested Materials, Equipment and Technology Resources</b>
<ol style="list-style-type: none"> <li>I. Career Opportunities                             <ol style="list-style-type: none"> <li>A. Bioengineers</li> <li>B. Biotechnologist</li> <li>C. Field Evaluation Technicians</li> <li>D. Greenhouse Assistants</li> <li>E. Plant Laboratory Assistants</li> <li>F. Plant Breeders</li> <li>G. Research Associates</li> </ol> </li> <li>II. Entrepreneurship                             <ol style="list-style-type: none"> <li>A. Career Service Representatives</li> <li>B. Public Affairs/Communications Specialist</li> <li>C. Sales Representatives</li> </ol> </li> <li>III. Expectations                             <ol style="list-style-type: none"> <li>A. Soil media Technicians</li> <li>B. Media Prep Technicians</li> </ol> </li> </ol>	<p>Lecture                      Guest speakers                      Inquiry                      Field trips                      Case study</p>	<p>Computer and printer                      CDs                      Videos                      Support materials                      Teacher designed materials</p>

C. Quality Assurance Auditors D. Validation Technicians		
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<b>Unit Assessment:</b>	Participation in discussion, research report, group investigation report
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<b>Unit/Course CTSO Activity:</b>	Students will participate in Career Development Events and Personal S.A.E.
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<b>Unit/Course Culminating Product:</b>	Students will complete a report on a chosen career.
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<b>Course/Program Credential(s):</b> <input type="checkbox"/> Credential <input type="checkbox"/> Certificate <input type="checkbox"/> Postsecondary Degree <input checked="" type="checkbox"/> University Degree <input type="checkbox"/> Other:
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**Course Title: Plant Biotechnology**

<b>Unit: 2</b>	<b>Safety</b>
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<b>Content Standard(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <ol style="list-style-type: none"> <li>Identify safety considerations and procedures required for plant biotechnology.</li> </ol> <p>Examples: biohazards, chemical hazards, laboratory protocol, waste disposal</p>
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<b>Learning Objective(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <ol style="list-style-type: none"> <li>Explain why accidents occur.</li> <li>Describe ways to prevent accidents.</li> <li>Identify personal protective equipment and how it is used.</li> </ol>
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<b>Essential Question(s):</b>	What are some safety considerations and procedures for plant biotechnology?
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<b>Content Knowledge</b>	<b>Suggested Instructional Activities Rigor &amp; Relevance Framework (Quadrant)</b>	<b>Suggested Materials, Equipment and Technology Resources</b>
I. Safety Considerations and Procedures <ol style="list-style-type: none"> <li>Accidents defined</li> <li>Accident prevention</li> <li>Personal protective equipment</li> </ol>	Guest speakers Case studies Inquiry Research Worksheets Field trips	Computer and printer CDs Software Handouts Videos Lab equipment Student equipment

<b>Unit Assessment:</b>	Participation in discussion, homework, inventories, posters, scenarios
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<b>Unit/Course CTSO Activity:</b>	
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**Unit/Course  
Culminating  
Product:**

Students will design a safety program for working in the biotechnology industry.

**Course/Program Credential(s):**  Credential  Certificate  Postsecondary Degree  University Degree  
 Other:



	<ul style="list-style-type: none"> <li>• Dissecting seed types to compare anatomical characteristics</li> <li>• Comparing the germination rates of various seeds</li> </ul> <p>13. Describe various natural and artificial methods of vegetative propagation.  Examples: natural- stem runners, rhizomes, bulbs, tubers  artificial- cutting, grafting, layering</p> <ul style="list-style-type: none"> <li>• Monitoring asexual plant propagation through leaf and stem cuttings</li> </ul> <p>14. Describe the ecological and economic importance of plants.  Examples: ecological-algae-producing oxygen, bioremediation, soil preservation  economic-food, medication, timber, fossil fuels, clothing</p> <ul style="list-style-type: none"> <li>• Analyzing effects of human activity on the plant world</li> </ul> <p>15. Identify viral, fungal, and bacterial plant diseases and their effects.  Examples: viral-tobacco mosaic, Rembrandt tulips;  fungal-mildew, rust  bacterial-black rot</p>
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<p><b>Learning Objective(s) and Depth of Knowledge Level(s):</b></p>	<p>Students will:</p> <ol style="list-style-type: none"> <li>1. Describe the system used in the classification of native Alabama plants.</li> <li>2. Classify native Alabama plants using dichotomous keys.</li> <li>3. Describe the difference between vascular and nonvascular plants.</li> <li>4. Determine if plants are seed bearing or spore bearing.</li> <li>5. Determine if plants are gymnosperms or angiosperms.</li> <li>6. Describe the differences between monocots and dicots.</li> <li>7. Determine the mutual relationship among algae and fungi in lichens.</li> <li>8. Discuss the alternation of generations of plants.</li> <li>9. Compare the characteristics of plants and algae.</li> <li>10. Describe the techniques of tissue culture.</li> <li>11. Discuss the plant tissues in the roots, stems and leaves.</li> <li>12. Explain the variations found in root structures, stems, and leaves.</li> <li>13. Trace the movement of minerals, water, and nutrients in plants.</li> <li>14. Identify the requirements for hydroponics plant production.</li> <li>15. Describe the various hydroponics systems.</li> <li>16. Compare the activity in a plant during exposure to light and periods of darkness.</li> <li>17. Identify plant growth regulators and their functions.</li> <li>18. Explain plant tropisms.</li> <li>19. Describe commercial uses of plant growth regulators.</li> <li>20. Discuss the various life-cycles of plants.</li> <li>21. Explain the differences in sexual and asexual reproduction in plants.</li> <li>22. Discuss the differences between monocot and dicot.</li> <li>23. Identify the major parts of seeds and their function.</li> </ol>
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24. Compare the germination rate of seeds.
25. State the primary methods of asexual reproduction and give examples of plants typically propagated by each method.
26. Explain environment and the issues associated with maintaining a good environment.
27. Explain the ecological and economical importance of plants.
28. Define plant disease and identify the conditions necessary for a plant disease to develop.

**Essential  
Question(s):**

What criteria should a student need to discuss the role of plants?

<b>Content Knowledge</b>	<b>Suggested Instructional Activities Rigor &amp; Relevance Framework (Quadrant)</b>	<b>Suggested Materials, Equipment and Technology Resources</b>
<p>I. Twelve Plant Kingdoms Divisions</p> <p>A. Plant Divisions</p> <ol style="list-style-type: none"> <li>1. Rhodophyta</li> <li>2. Cryptophyta</li> <li>3. Dinophyta</li> <li>4. Xanthophyta</li> <li>5. Chrysophyta</li> <li>6. Bacillariophyta</li> <li>7. Phaeophyta</li> <li>8. Chlorophyta</li> <li>9. Prasinophyta</li> <li>10. Charophyta</li> <li>11. Euglenophyta</li> <li>12. Bryophyta</li> </ol> <p>B. Phylogenetic relationships</p> <ol style="list-style-type: none"> <li>1. Vascular</li> <li>2. Nonvascular</li> <li>3. Seed-bearing</li> <li>4. Spore-bearing</li> <li>5. Gymnosperms</li> <li>6. Angiosperms</li> <li>7. Monocots</li> <li>8. Dicots</li> <li>9. Mutualism (algae, fungi)</li> </ol> <p>C. Plant adaptations</p> <ol style="list-style-type: none"> <li>1. Alterations of generations</li> <li>2. Comparing characteristics</li> </ol> <p>D. Major plant tissues</p>	<p>Application cards  Collaborative learning  Flash cards  Worksheets  Memorization  Laboratory  Experiments  Application cards  Case studies/scenarios  Research  Guided practice  Guest Speakers  Demonstrations  Inquiry  Learning Logs  Instructional Technology  PowerPoint Presentation</p>	<p>Application cards  Handouts  Checklists  Lead questions  Computer and printer  Textbooks  Internet  Rubric for project  Reference books  Supplies  PowerPoint Presentation  Lab Supplies</p>

<ul style="list-style-type: none"> <li>1. Tissue culturing</li> <li>E. Types of roots, stems, and leaves</li> <li>F. Soil types, texture, and nutrients <ul style="list-style-type: none"> <li>1. Water and mineral absorption</li> <li>2. Capillarity and turgor pressure</li> <li>3. Hydroponics</li> </ul> </li> <li>G. Plant cell processes</li> <li>H. Plant stimuli response <ul style="list-style-type: none"> <li>1. Effects of hormones</li> <li>2. Tropisms</li> <li>3. Propagating</li> </ul> </li> <li>I. Identify life cycles</li> <li>J. Structure and function of flower parts <ul style="list-style-type: none"> <li>1. Seed germination, development and dispersal</li> <li>2. Germinating Monocot and Dicot</li> <li>3. Dissecting seeds</li> <li>4. Germination rates</li> </ul> </li> <li>K. Natural and artificial germination <ul style="list-style-type: none"> <li>1. Asexual propagation</li> </ul> </li> <li>L. Ecological and economic importance <ul style="list-style-type: none"> <li>1. Effects of human activity</li> </ul> </li> <li>M. Viral, fungal, and bacterial disease</li> </ul>		
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<b>Unit Assessment:</b>	Tests, research report, performance tasks, oral presentations, checklist, demonstrations, checklist, group project, essays, experiments, and teacher observations
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<b>Unit/Course CTSO Activity:</b>	Students will participate in Nursery and Landscape Career Development event and personal S.A.E.
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<b>Unit/Course Culminating Product:</b>	Students will create a PowerPoint presentation culminating the information for discussing the role of plants.
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**Course/Program Credential(s):**  Credential  Certificate  Postsecondary Degree  University Degree

Other:

**Course Title: Plant Biotechnology**

<b>Unit: 4</b>	<b>Biotechnology Advancement</b>
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<b>Content Standard(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <p>16. Explain the historical development of plant biotechnology.                  Examples: making cheese, wine, bread; distilling vinegar; pickling fruits and vegetables</p>
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<b>Learning Objective(s) and Depth of Knowledge Level(s):</b>	<p>Students will:</p> <ol style="list-style-type: none"> <li>Identify medical advancements in plant biotechnology.                      Examples: insulin, vaccines, vitamin enrichment of grains, therapeutic proteins</li> <li>Describe environmental advancements in plant biotechnology.                      Examples: reduced pesticide usage, lower energy requirements, disease-resistant plants, herbicide-resistant plants, bioremediation, phytoremediation</li> <li>Describe food product advancements in plant biotechnology, in genetic alteration and selective breeding.                      Examples: increase yield, potatoes with higher solid content, higher protein peanuts, tomatoes with longer shelf life, <i>Bacillus thuringiensis</i> (Bt) corn</li> <li>Replicating a historical use of biotechnology.                      Examples: making bread, cheese, yogurt, sauerkraut</li> </ol>
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<b>Essential Question(s):</b>	What are the advancements in plant biotechnology?
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<b>Content Knowledge</b>	<b>Suggested Instructional Activities Rigor &amp; Relevance Framework (Quadrant)</b>	<b>Suggested Materials, Equipment and Technology Resources</b>
I. Historical Development of Plant Biotechnology A. Medical advancements 1. Insulin 2. Vaccines 3. Vitamin enrichment of grains 4. Therapeutic proteins B. Environmental advancements 1. Reduced pesticide usage 2. Lower energy requirements	Research report Inquiry Instructional technology Lecture Research project Case study Homework Guest speakers Experiment Guided practice	Computer and printer Textbooks Support materials PowerPoint Presentation Charts Video Supplies Rating charts Rubrics Checklists

<ul style="list-style-type: none"> <li>3. Disease-resistant plants</li> <li>4. Herbicide-resistant plants</li> <li>5. Bioremediation</li> <li>6. Phytoremediation</li> </ul> <p>C. Food product advancements</p> <ul style="list-style-type: none"> <li>1. Increased yield</li> <li>2. Potatoes with higher solid content</li> <li>3. Higher protein peanuts</li> <li>4. Tomatoes with longer shelf life</li> <li>5. Bacillus thuringiensis corn</li> </ul> <p>D. Historical biotechnology</p> <ul style="list-style-type: none"> <li>1. Bread</li> <li>2. Cheese</li> <li>3. Yogurt</li> <li>4. Sauerkraut</li> </ul>	<p>Collaborative learning PowerPoint Presentation</p>	<p>Teacher designed materials</p>
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<b>Unit Assessment:</b>	Tests, performance tasks, essays, oral presentations, experiments, online activities, teacher observations, rubrics, computer presentations, extended task assignments
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<b>Unit/Course CTSO Activity:</b>	
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<b>Unit/Course Culminating Product:</b>	Students will create a research project based on the advancements in biotechnology.
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<b>Course/Program Credential(s):</b> <input type="checkbox"/> Credential <input type="checkbox"/> Certificate <input type="checkbox"/> Postsecondary Degree <input checked="" type="checkbox"/> University Degree <input type="checkbox"/> Other:
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**Course Title: Plant Biotechnology**

<b>Unit: 5</b>	<b>Applied Genetics and Biotechnology Concepts</b>
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<p><b>Content Standard(s) and Depth of Knowledge Level(s):</b></p>	<p>Students will:</p> <p>17. Describe methods of genetic engineering.              Example: tissue culturing, plant breeding, genetic modification</p> <p>18. Explain the concept of hybridization as it relates to plant biotechnology.</p> <p>19. Evaluate properties of plants for selecting superior plants for harvest.              Example: cold tolerance, salt tolerance, ripening rate, higher starch content, vitamin A content, water and mineral absorption</p>
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<p><b>Learning Objective(s) and Depth of Knowledge Level(s):</b></p>	<p>Students will:</p> <ol style="list-style-type: none"> <li>1. Extract DNA from plant cells.</li> <li>2. Define genetically modified.</li> <li>3. Explain how vectors are used to insert DNA into an organism.</li> <li>4. Describe the process of splicing DNA into plants.</li> <li>5. Discuss hybridization.</li> <li>6. Discuss the process selecting superior plants.</li> </ol>
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<p><b>Essential Question(s):</b></p>	<p>What is the method and purpose in selecting plants for genetic engineering?</p>
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Content Knowledge	Suggested Instructional Activities Rigor & Relevance Framework (Quadrant)	Suggested Materials, Equipment and Technology Resources
<p>I. Methods of Genetic Engineering</p> <p>A. Extracting DNA from plants</p> <ol style="list-style-type: none"> <li>1. Extracting DNA</li> <li>2. Splicing DNA</li> <li>3. Inserting DNA</li> </ol> <p>B. Explain the concept of hybridization</p> <ol style="list-style-type: none"> <li>1. Hybrid vigor</li> <li>2. Improvement by selection</li> <li>3. Selective breeding</li> </ol> <p>C. Properties for selection</p> <ol style="list-style-type: none"> <li>1. Cold tolerance</li> <li>2. Salt tolerance</li> </ol>	<p>Laboratory</p> <p>Experiment</p> <p>Lecture</p> <p>Guest speaker</p> <p>Field trip/virtual field trip</p> <p>PowerPoint Presentation</p> <p>Inquiry</p> <p>Observation log</p> <p>Learning logs</p>	<p>CDs</p> <p>Textbooks</p> <p>Reference books</p> <p>Rubrics</p> <p>Handouts</p> <p>Supplies</p> <p>Videos</p> <p>Software</p> <p>Lab supplies</p> <p>Student equipment</p> <p>Computer and printer</p> <p>Video camera &amp; monitor</p> <p>Websites</p>

<ul style="list-style-type: none"> <li>3. Ripening rate</li> <li>4. Higher starch content</li> <li>5. Vitamin A</li> <li>6. Water and mineral absorption</li> </ul>		Internet Teacher design materials
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<b>Unit Assessment:</b>	Tests, performance tasks, extended response exercises, checklist, projects, research projects, rating scales
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<b>Unit/Course CTSO Activity:</b>	Student will participate in the Nursery and landscape Career Development event and personal SAE.
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<b>Unit/Course Culminating Product:</b>	Students will create a research project outlining the advantages and disadvantages of genetic engineering of plants.
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<b>Course/Program Credential(s):</b> <input type="checkbox"/> Credential <input type="checkbox"/> Certificate <input type="checkbox"/> Postsecondary Degree <input checked="" type="checkbox"/> University Degree <input type="checkbox"/> Other:
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**Course Title: Plant Biotechnology**

<b>Unit: 6</b>	<b>Social and Environmental Impacts of Biotechnology</b>
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<p><b>Content Standard(s) and Depth of Knowledge Level(s):</b></p>	<p>Students will:</p> <p>20. Identify public agencies that conduct research and regulate the usage of plant biotechnology.          Examples: United States Department of Agriculture (USDA), Environmental Protection Agency (EPA), Food and Drug Administration (FDA)</p> <ul style="list-style-type: none"> <li>• Describing positive and negative aspects of labeling genetically modified organisms for import and export.</li> <li>• Evaluating the effects of plant hormones on plants, animals, and human growth and development.          Examples: indigenous hormones, intentionally introduced hormones, unintentionally introduced hormones</li> <li>• Describing how public opinion on marketing, sales, labeling, and government regulations affect plant products grown in the United States.</li> </ul>
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<p><b>Learning Objective(s) and Depth of Knowledge Level(s):</b></p>	<p>Students will:</p> <ol style="list-style-type: none"> <li>1. Describe positive and negative aspects of labeling genetically modified organisms for import and export.</li> <li>2. Evaluate the effects of plants hormones on plants, animals, and human growth and development.          Examples: indigenous hormones, intentionally introduced hormones, unintentionally introduced hormones</li> <li>3. Describe how public opinion on marketing, sales, labeling, and government regulations affect plant products grown in the United States.</li> <li>4. Testing foodstuffs for the presence of genetically modified organisms.</li> </ol>
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<p><b>Essential Question(s):</b></p>	<p>What agencies regulate the usage of plant biotechnology?</p>
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Content Knowledge	Suggested Instructional Activities Rigor & Relevance Framework (Quadrant)	Suggested Materials, Equipment and Technology Resources
<p>I. Public Agencies that Research and Regulate Plant Biotechnology</p> <p>A. Positive and negative aspects of labeling</p> <p>B. Effects of plant hormones</p> <ol style="list-style-type: none"> <li>1. Indigenous hormones</li> <li>2. Intentionally introduced hormones</li> <li>3. Unintentionally introduced hormones</li> </ol>	<p>PowerPoint Presentation</p> <p>Research</p> <p>Case studies/scenarios</p> <p>Inquiry</p> <p>Guest speakers</p> <p>Lecture</p> <p>Group investigation</p> <p>Listen-think-pair-share</p> <p>Two minute talks</p>	<p>Computer and Printer</p> <p>Textbooks</p> <p>Handouts</p> <p>Supplies</p> <p>Software</p> <p>Support materials</p> <p>Rubrics</p> <p>Handouts</p>

C. Affect of public opinion D. Testing foodstuffs		
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<b>Unit Assessment:</b>	Tests, open-ended questions, oral presentations, experiments, group projects, case studies, debates, computer presentations, teacher observations
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<b>Unit/Course CTSO Activity:</b>	Students will participate in the Nursery Landscape Career Development Event and personal S.A.E.
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<b>Unit/Course Culminating Product:</b>	Students will produce a research project discussing how plant biotechnology is regulated and what agencies perform the regulation.
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<b>Course/Program Credential(s):</b> <input type="checkbox"/> Credential <input type="checkbox"/> Certificate <input type="checkbox"/> Postsecondary Degree <input checked="" type="checkbox"/> University Degree <input type="checkbox"/> Other:
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