Program of Study Justifications for Agriculture, Food, & Natural Resources

<table>
<thead>
<tr>
<th>Program of Study</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Engineering and Applied Technologies</td>
<td>2</td>
</tr>
<tr>
<td>Agribusiness</td>
<td>10</td>
</tr>
<tr>
<td>Environmental and Natural Resource Management</td>
<td>18</td>
</tr>
<tr>
<td>Food Science</td>
<td>26</td>
</tr>
<tr>
<td>Horticulture Science</td>
<td>34</td>
</tr>
<tr>
<td>Veterinary and Animal Science</td>
<td>43</td>
</tr>
</tbody>
</table>
Agricultural Engineering and Applied Technologies

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Engineering and Applied Technologies</td>
<td>Agriscience* (5957)</td>
<td>Principles of Agricultural Mechanics (5944)</td>
<td>Agricultural Power and Equipment (5945) -or- Dual Enrollment Agricultural Engineering &amp; Applied Technologies (4066)</td>
<td>Agricultural and Biosystems Engineering (5963) -or- Dual Enrollment Agricultural Engineering &amp; Applied Technologies (4066)</td>
</tr>
<tr>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Earns science credit

**Description**

**Agricultural engineering and applied technologies** prepares students for careers or further study in engineering, environmental science, agricultural design and research, and agricultural mechanics. The program of study content covers navigation, maintenance, repair, and overhaul of electrical motors, hydraulic systems, and fuel-powered engines with special emphasis given to geographic information systems (GIS) and global positioning systems (GPS) applications to achieve various agricultural goals. Upon completion of this program of study, students will be prepared for immediate application of these skills in a career setting or pursue further study at the postsecondary level.

Students can gain job experience while in high school through supervised agricultural experience (SAE) program or work-based learning. Supervised agricultural experience is a structured experiential learning opportunity for Agriculture, Food, and Natural Resources (AFNR) students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.

**Job Outlook**

Implementation of the Governor’s Rural Challenge: A 10-Year Strategic Plan focuses on growth and prosperity of the agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skillsets for agricultural jobs are more complex and have an increased focus on technology.1

---

Production agriculture continues to be a dominant factor in our state's landscape with over 67,300 farms producing and selling crops, livestock, forest productions, and manufactured or processed agricultural products. All which depends on skilled workers from this program of study area to help produce, harvest, equip, repair, distribute, and process the products as efficiently and safely as possible using current technologies.

A majority of the jobs associated within the agricultural engineering and applied technologies program of study are projected to have an annual average growth ranges from zero to 18 percent as shown in Figure 1. Architectural and engineering managers has the most potential for occupational growth and highest median salary for the aligned agricultural engineering and applied technology occupations as illustrated in Figure 2. Farm equipment mechanics and service technicians state and national projection employment trends in Figure 3 shows a higher percentage growth by the year 2024.  

Tennessee's robust agricultural production alone, excluding forest products, generates approximately $2.5 billion annually in farm cash receipts. The agro-forestry industry employed over 363,500 people or 10.3 percent of the state's total workers. This economic and employment impact provides the justification for the need to increase the scope and depth for a skilled and educated workforce within the AEAT program of study.

---


Figure 1. Tennessee employment projections for agricultural engineering and applied technology related occupations with positive job openings projected 2014-24.6 7

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11-9041 Architectural and Engineering Managers</td>
<td>2,640</td>
<td>3,070</td>
<td>110</td>
<td>16%</td>
<td>$114,670</td>
</tr>
<tr>
<td>49-3041 Farm Equipment Mechanics and Service Technicians</td>
<td>810</td>
<td>910</td>
<td>100</td>
<td>12%</td>
<td>$32,740</td>
</tr>
<tr>
<td>45-2091 Agricultural Equipment Operators</td>
<td>1,190</td>
<td>1,200</td>
<td>40</td>
<td>0%</td>
<td>$26,690</td>
</tr>
<tr>
<td>17-2021 Agricultural Engineers</td>
<td>2,900</td>
<td>3,000</td>
<td>100</td>
<td>4%</td>
<td>Data Not Available*</td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Power Machinery Operation</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>25-1032 Engineering Teachers, Postsecondary Agricultural Mechanization</td>
<td>640</td>
<td>750</td>
<td>20</td>
<td>18%</td>
<td>$95,540</td>
</tr>
</tbody>
</table>

*Data was not available or provided due to confidentiality regulations.

Figure 2. 2024 Tennessee employment projections architectural and engineering managers.8

Figure 3. State and national trends for farm equipment mechanics and service technicians with positive projections 2014-24.

<table>
<thead>
<tr>
<th>National</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>49-3041 Farm Equipment Mechanics and Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technicians</td>
<td>40,300</td>
<td>43,200</td>
<td>7%</td>
</tr>
</tbody>
</table>

Tennessee

<table>
<thead>
<tr>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>49-3041 Farm Equipment Mechanics and Service</td>
<td>810</td>
<td>910</td>
</tr>
<tr>
<td>Technicians</td>
<td>12%</td>
<td>40</td>
</tr>
</tbody>
</table>

Postsecondary Pathways

Upon completion of this program of study, students will be prepared for a wide range of career opportunities that links to each of the agriculture, food, and natural resources postsecondary pathway. This includes BS degrees focusing in Biosystems Engineering, Engineering Technology, and Agricultural Sciences as outline in Figure 4 with related career opportunities and training necessary for each. Some occupations require a high school diploma, BS degree.

---

Current Secondary Landscape

In the 2015-16 school year, 109 schools in Tennessee offered courses in the agricultural engineering and applied technologies program of study with 8,013 enrolled in the courses. This program of study is the third largest enrollment, 22 percent, of all the Agriculture, Food, and Natural Resources programs. Of that group only 2,668 students were enrolled in the Principles of Agricultural Mechanics, the level two course and steadily decreased through the level four course, Agricultural and Biosystems Engineering, with 783 students.10 Figure 5 shows the open enrollment, student enrollment, and concentrators from 2013-14 SY to projections for 2016-17 SY.11 Figure 6 show the distribution of agricultural engineering and applied technologies programs of study.12

---

Figure 5. Open Enrollment Analysis\(^{13}\)

<table>
<thead>
<tr>
<th>SY</th>
<th>Agricultural Engineering and Applied Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No data</td>
</tr>
<tr>
<td>2014-15</td>
<td>106</td>
</tr>
<tr>
<td>2015-16</td>
<td>109</td>
</tr>
<tr>
<td>2016-17</td>
<td>118</td>
</tr>
<tr>
<td>2017-18*</td>
<td>110*</td>
</tr>
</tbody>
</table>

*Preliminary data

Student Enrollment

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience (Introduction course for all POSs)</th>
<th>Principles of Agricultural Mechanics</th>
<th>Agricultural Power and Equipment</th>
<th>Agricultural and Biosystems Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>2,416</td>
<td>1,710</td>
<td>1,186</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>3,022</td>
<td>1,571</td>
<td>870</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>2,668</td>
<td>1,630</td>
<td>783</td>
</tr>
<tr>
<td>2016-17*</td>
<td>17,990</td>
<td>3,607</td>
<td>2,167</td>
<td>1079</td>
</tr>
</tbody>
</table>

*Preliminary data

Agricultural Engineering and Applied Technologies Concentrators

<table>
<thead>
<tr>
<th>SY</th>
<th>Agricultural Engineering and Applied Technologies Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>874</td>
</tr>
<tr>
<td>2014-15</td>
<td>739</td>
</tr>
<tr>
<td>2015-16</td>
<td>890</td>
</tr>
</tbody>
</table>

Figure 6. Distribution of Agricultural Engineering and Applied Technology programs of study\(^{14}\)

\(^{13}\) Tennessee Department of Education. (2017). Student Enrollment Data. Retrieved from Author’s calculation of student enrollment data.

The agricultural engineering and applied technologies program of study implemented standards align with the Governor's Rural Challenge to advance the focus on STEM technologies and to increase the scope and depth of a skilled and educated workforce for the agriculture industry. Incorporation of geographic information systems (GIS), global positioning systems (GPS), and Unmanned Aerial Systems throughout this program of study has allowed the preparation of students to enter new growing highly technical areas of the agriculture industry. Dual enrollment opportunities help ensure the rigor and bridge the gap to additional postsecondary training for additional credentialing.

**Recommendation**

No additional recommendations.

<table>
<thead>
<tr>
<th>2018-19 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural Engineering and Applied Technologies</strong></td>
<td>Agriscience * (5957)</td>
<td>Principles of Agricultural Mechanics (5944)</td>
<td>Agricultural Power and Equipment (5945) -or- <strong>Dual Enrollment</strong></td>
<td>Agricultural and Biosystems Engineering (5963) -or- <strong>Dual Enrollment</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Agricultural Engineering &amp; Applied Technologies (4066)</strong></td>
<td><strong>Agricultural Engineering &amp; Applied Technologies (4066)</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Supervised Agricultural Experience (5964)</strong></td>
</tr>
</tbody>
</table>
References


Agribusiness

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agribusiness</td>
<td>Agriscience* (5957)</td>
<td>Principles of Agribusiness (5946)</td>
<td>Organizational Leadership and Communications (5956) -or- Dual Enrollment Agribusiness (4067)</td>
<td>Agricultural Business and Finance** (5943) -or- Statewide Dual Credit Intro to Agribusiness** (4270) -or- Dual Enrollment Agribusiness (4067)</td>
</tr>
</tbody>
</table>

Supervised Agricultural Experience (5964)

*Earns science credit, **Counts as personal finance credit

**Description**

The Agribusiness program of study prepares students to apply the economic and business principles involved in the sale and supply of agricultural products to a wide range of careers across the industry. In addition to building foundational knowledge of finance and marketing principles as they apply to agricultural businesses, courses develop the student’s essential leadership, management, and communication skills to succeed in agribusiness careers. The program of study allows the student to satisfy science and personal finance credit required for graduation and earn postsecondary credit. Upon completion of this program of study, students will equipped with strong knowledge and skill preparation for advanced business courses at the postsecondary level and career opportunities in many agribusiness-related fields.

Students can gain job experience while in high school through supervised agricultural experience (SAE) program or work-based learning. Supervised agricultural experience is a structured experiential learning opportunity for Agriculture, Food, and Natural Resources (AFNR) students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.

**Job Outlook**

According to the United States Department of Agriculture’s National Institute of Food and Agriculture report and Purdue University, there are nearly 60,000 high-skilled agriculture job openings expected annually in the U.S. An average of 35,400 graduates with AFNR expertise will be available to fill them. These jobs will only become more...
important as we continue to develop solutions to feed more than 9 billion people by 2050. The report projects almost half of the job opportunities will be in management and business.¹

Implementation of the *Governor's Rural Challenge: A 10-Year Strategic Plan* focuses on growth and prosperity of the agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skillsets for agricultural jobs are more complex and have an increased focus on technology.²

The agribusiness program of study provides a wide range of career opportunities that links to each of the agriculture, food, and natural resources postsecondary pathway and to a variety of related business careers. As consumers purchase more fresh foods and build houses the need for individuals with related purchasing, marketing strategies, and management opportunities will increase.³

*Figure 1* shows a sampling of aligned agribusiness-related career opportunities for students completing the agribusiness program of study buyers and purchasing agents of farm products to audio and video equipment technicians.⁴ Buyers and purchasing agents of farm products occupations are increasing in the urban areas of the state as shown in *Figure 2*, but remains strong for this program of study.⁵ See *Figure 3* for a comparison of state and national employment trends for agricultural science teacher, postsecondary agribusiness management.⁶

---


Figure 1. Tennessee employment projections for agribusiness related occupations with positive job openings projected for 2014-24\(^7\)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13-1021 Buyers and Purchasing Agents, Farm Products</td>
<td>260</td>
<td>300</td>
<td>40</td>
<td>16%</td>
<td>$58,430</td>
</tr>
<tr>
<td>13-2072 Loan Officers</td>
<td>5,800</td>
<td>6,380</td>
<td>580</td>
<td>8%</td>
<td>$58,590</td>
</tr>
<tr>
<td>15-1151 Computer User Support Specialists</td>
<td>7,430</td>
<td>9,360</td>
<td>310</td>
<td>26%</td>
<td>$45,500</td>
</tr>
<tr>
<td>19-3011 Economist</td>
<td>70</td>
<td>80</td>
<td>0</td>
<td>10%</td>
<td>$80,860</td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Agribusiness Management</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>25-9021 Farm and Home Management Advisors</td>
<td>150</td>
<td>170</td>
<td>20</td>
<td>15%</td>
<td>$42,790</td>
</tr>
<tr>
<td>27-1024 Graphic Designers</td>
<td>3,880</td>
<td>4,090</td>
<td>120</td>
<td>6%</td>
<td>$41,770</td>
</tr>
<tr>
<td>27-4011 Audio and Video Equipment Technicians</td>
<td>1,720</td>
<td>1,920</td>
<td>50</td>
<td>12%</td>
<td>$38,120</td>
</tr>
</tbody>
</table>


Figure 2. 2024 Tennessee employment projections for buyers and purchasing agents of farm products.\(^9\)

![Map showing Tennessee employment projections](image)

<table>
<thead>
<tr>
<th>2024 Projected Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Figure 3. State and national trends for agricultural science teacher, postsecondary agribusiness management for 2014-24\(^{10}\)

<table>
<thead>
<tr>
<th>National</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Agribusiness Management</td>
<td>12,100</td>
<td>12,800</td>
<td>6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tennessee</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Agribusiness Management</td>
<td>260</td>
<td>290</td>
<td>14%</td>
</tr>
</tbody>
</table>

---


Tennessee’s robust agricultural production alone, excluding forest products, generates approximately $2.5 billion annually in farm cash receipts. The agro-forestry industry employed over 363,500 people or 10.3 percent of the state’s total workers. This economic and employment impact provides the justification for the need for skilled workers within the Agribusiness program of study.

**Postsecondary Pathways**

Upon completion of this program of study, students will be prepared for a range of career opportunities that links to each of the agriculture, food, and natural resources postsecondary pathway. Figure 4 outlines the related career opportunities and training necessary for each. While some occupations require a high school diploma or some postsecondary training, the highest paid occupations require a bachelor’s degree or advanced degree.

**Figure 4. Postsecondary Pathways**

---


**Current Secondary Landscape**

In the 2015-16 school year, 33 schools in Tennessee offered courses in the agribusiness program of study with 2,123 enrolled in the courses. Of these, 172 students in 13 programs participating in the statewide dual credit Agricultural Business Finance/Introduction to Agribusiness course. This program of study had the fifth largest enrollment, six percent, of all the Agriculture, Food, and Natural Resources programs. Of that group only 308 students were enrolled in the Principles of Agribusiness, the level two course and steadily increased through the level four course, Agricultural Business and Finance, with 563 students. Figure 5 shows the open enrollment, student enrollment, and concentrators from 2013-14 SY to projections for 2016-17 SY. Figure 6 show the distribution of agribusiness programs of study.

**Figure 5. Open Enrollment Analysis**

<table>
<thead>
<tr>
<th>SY</th>
<th>Agribusiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No data</td>
</tr>
<tr>
<td>2014-15</td>
<td>30</td>
</tr>
<tr>
<td>2015-16</td>
<td>33</td>
</tr>
<tr>
<td>2016-17</td>
<td>40</td>
</tr>
<tr>
<td>2017-18</td>
<td>47</td>
</tr>
</tbody>
</table>

**Student Enrollment**

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience</th>
<th>Principles of Agribusiness</th>
<th>Organizational Leadership and Communications</th>
<th>Agricultural Business and Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>67</td>
<td>587</td>
<td>189</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>283</td>
<td>583</td>
<td>531</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>308</td>
<td>452</td>
<td>563</td>
</tr>
<tr>
<td>2016-17</td>
<td>17,990</td>
<td>333</td>
<td>707</td>
<td>563</td>
</tr>
</tbody>
</table>

**Agricultural Engineering and Applied Technologies Concentrators**

<table>
<thead>
<tr>
<th>SY</th>
<th>Agribusiness Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>17</td>
</tr>
<tr>
<td>2014-15</td>
<td>100</td>
</tr>
<tr>
<td>2015-16</td>
<td>108</td>
</tr>
</tbody>
</table>

---

Recommendation
No additional recommendations at this time.

<table>
<thead>
<tr>
<th>Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agribusiness</td>
<td>Agriscience (5957)</td>
<td>Principles of Agribusiness (5946)</td>
<td>Organizational Leadership and Communications (5956)</td>
<td>Agricultural Business and Finance(^2) (5943)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-or-</td>
<td>-or-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dual Enrollment Agribusiness (4067)</td>
<td>Statewide Dual Credit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intro to Agribusiness (4270)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-or-    Dual Enrollment Agribusiness (4067)</td>
</tr>
</tbody>
</table>

Supervised Agricultural Experience (5964)

---

References


Environmental and Natural Resource Management

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental and Natural Resource Management</td>
<td>Agriscience* (5957)</td>
<td>Applied Environmental Science¹ (6114)</td>
<td>Plant and Soil Science (5950)</td>
<td>Natural Resources Management (6117)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-or- Dual Enrollment Environmental &amp; Natural Resources Management (4070)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-and/or- AP Environmental Science (3236)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-or- Dual Enrollment Environmental &amp; Natural Resources Management (4070)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
</tr>
</tbody>
</table>

*Earns science credit

**Description**

Environmental and natural resource management focuses on developing knowledge and skills needed for students interested in becoming good stewards of our environment and natural resources, such as environmental scientist, conservationist, foresters, or wildlife managers. Students will earn science credit required for graduation while developing the knowledge and skills of this program of study. Upon completion of this program of study, students will be prepared for a range of careers or transition to postsecondary pathways associated with the environmental science, science and management of plants, soils, wildlife, and natural resources.

Students can gain job experience while in high school through supervised agricultural experience (SAE) program or work-based learning. Supervised agricultural experience is a structured experiential learning opportunity for agriculture, food, and natural resources (AFNR) students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.

**Job Outlook**

The United States Department of Agriculture recently released an employment impact report showing nearly 60,000 high-skilled annual job openings between 2015 and 2020 in the food, agriculture, renewable natural resources, and environment fields with only an average of 35,000 new college graduates each year. They predict to expect a strong employment market for ecosystems managers, agricultural science and business educators, crop advisors, and pest
control specialist. Expect the strongest job market for plant scientists, sustainable biomaterials specialist, water resources scientists, and engineers and precision agriculture specialist. ¹

Implementation of the Governor’s Rural Challenge: A 10-Year Strategic Plan focuses on growth and prosperity of agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skill sets for agricultural jobs are more complex and have an increased focus on technology such as geographic information systems (GIS) and global positioning systems (GPS) technologies.² This includes identifying water issues and needs throughout the state.³

According to the Tennessee Department of Environment and Conservation, Tennessee needs employees with diverse and dynamic skill sets to continue safeguarding the health and safety of Tennessee citizens from environmental hazards, protecting and improving the quality of Tennessee’s land, air and water.⁴ Figure 1 shows several aligned environmental and natural resources management occupations with positive employment ranging from one to 24 percent increase from 2014-2024. Figure 2 shows the distribution of managers for ecology, natural resources, and tourism. See Figure 3 for a comparison of state and national employment trends for environmental engineers.⁵

**Figure 1.** Tennessee employment projections for environmental and natural resources management related occupations with positive job openings projected 2014-2024.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11-9121 Natural Sciences Managers</td>
<td>510</td>
<td>530</td>
<td>10</td>
<td>5%</td>
<td>$103,440</td>
</tr>
<tr>
<td>17-2081 Environmental Engineers</td>
<td>1,010</td>
<td>1,220</td>
<td>210</td>
<td>21%</td>
<td>$81,560</td>
</tr>
<tr>
<td>11-9199 Managers, All Other (Ecology, Natural Resources &amp; Tourism)</td>
<td>12,500</td>
<td>13,790</td>
<td>400</td>
<td>10%</td>
<td>$77,780</td>
</tr>
<tr>
<td>19-2041 Environmental Scientists and Specialists, including health</td>
<td>1,370</td>
<td>1,480</td>
<td>110</td>
<td>8%</td>
<td>$60,400</td>
</tr>
<tr>
<td>19-1013 Soil and Plant Scientists</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>1%</td>
<td>$44,040</td>
</tr>
<tr>
<td>19-1022 Microbiologists</td>
<td>200</td>
<td>210</td>
<td>10</td>
<td>2%</td>
<td>$57,430</td>
</tr>
<tr>
<td>19-1031 Conservation Scientists</td>
<td>290</td>
<td>310</td>
<td>10</td>
<td>6%</td>
<td>$71,030</td>
</tr>
<tr>
<td>19-1099 Life Scientists, All Other</td>
<td>60</td>
<td>70</td>
<td>0</td>
<td>15%</td>
<td>$52,730</td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Soil, Agronomy, General</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>25-1042 Biological Science Teachers, Postsecondary</td>
<td>1,420</td>
<td>1,770</td>
<td>60</td>
<td>24%</td>
<td>$58,420</td>
</tr>
<tr>
<td>25-1043 Forestry and Conservation Science Teachers, Postsecondary</td>
<td>60</td>
<td>70</td>
<td>0</td>
<td>15%</td>
<td>$91,360</td>
</tr>
</tbody>
</table>

---


Figure 2. 2024 Tennessee employment projections for managers including ecology, natural resources, and tourism.\(^8\)

Figure 3. State and national trends for environmental engineers for 2014-24 \(^9\)

<table>
<thead>
<tr>
<th>National</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-2081 Environmental Engineers</td>
<td>55,100</td>
<td>12%</td>
<td>2,240</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tennessee</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-2081 Environmental Engineers</td>
<td>1,010</td>
<td>21%</td>
<td>50</td>
</tr>
</tbody>
</table>

\(^8\) Career One Stop. (2017). Occupation Profile, State and National Trends. Retrieved from [https://www.onetonline.org/link/summary/11-9199.00](https://www.onetonline.org/link/summary/11-9199.00)  
Postsecondary Pathways

Upon completion of this program of study, students will be prepared for a wide range of career opportunities that links to each of the AFNR programs of studies and several environmental science postsecondary pathways. Figure 4 outlines the related career opportunities and the training necessary for each. Whereas some occupations require a high school diploma, academy training, or a postsecondary certificate, several occupations require a bachelor's degree or higher (refer to Figure 1).

Figure 4. Postsecondary Pathways

Current Secondary Landscape

In the 2015-16 school year, 59 schools in Tennessee offered courses in the environmental and natural resources management program of study with 2,772 students or 22 percent of the AFNR enrollment. Of that group 739 students were enrolled in the Applied Environmental Science course, the level two course that receives science credit, 736 enrolled in the Plant and Soil Science course, Level three. The capstone course, Natural Resource Management, has the largest enrollment with 1,297 students. With the restructuring and realignment of the content standards to increase the rigor and improve relevance to meet industry employment trends, enrollment has declined. Figure 5 shows the open enrollment, student enrollment, and concentrators from 2013-14 SY to
projections for 2016-17 SY. Figure 6 shows the distribution of the environmental and natural resource management programs of study.

**Figure 5.** Open Enrollment Analysis

<table>
<thead>
<tr>
<th>SY</th>
<th>Environmental and Natural Resource Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No data</td>
</tr>
<tr>
<td>2014-15</td>
<td>58</td>
</tr>
<tr>
<td>2015-16</td>
<td>59</td>
</tr>
<tr>
<td>2016-17</td>
<td>68</td>
</tr>
<tr>
<td>2017-18*</td>
<td>74</td>
</tr>
</tbody>
</table>

*Preliminary data

**Student Enrollment**

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience (Introduction course for all POSs)</th>
<th>Applied Environmental Sciences</th>
<th>Plant &amp; Soil Sciences</th>
<th>Natural Resource Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>396</td>
<td></td>
<td>1325</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>854</td>
<td>665</td>
<td>1297</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>739</td>
<td>736</td>
<td>1256</td>
</tr>
<tr>
<td>2016-17*</td>
<td>17,990</td>
<td>730</td>
<td>671</td>
<td>1256</td>
</tr>
</tbody>
</table>

*Preliminary data

**Concentrators**

<table>
<thead>
<tr>
<th>SY</th>
<th>Environmental and Natural Resource Management Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>248</td>
</tr>
<tr>
<td>2014-15</td>
<td>258</td>
</tr>
<tr>
<td>2015-16</td>
<td>249</td>
</tr>
</tbody>
</table>

**Figure 6.** Distribution of environmental and natural resource management programs of study.

---

**Recommendation**
No additional recommendations.

<table>
<thead>
<tr>
<th>2018-19 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental and Natural Resource Management</td>
<td>Agriscience¹ (5957)</td>
<td>Applied Environmental Science¹ (6114)</td>
<td>Plant and Soil Science (5950) <strong>Dual Enrollment</strong> Environmental &amp; Natural Resources Management (4070)</td>
<td>Natural Resources Management (6117) <strong>Dual Enrollment</strong> Environmental &amp; Natural Resources Management (4070)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Supervised Agricultural Experience (5964)
References


# Food Science

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Science</td>
<td>Agriscience(^1) (5957)</td>
<td>Principles of Food Production (6118)</td>
<td>Food Science and Safety (6115) -or-</td>
<td>Advanced Food Science (6113) -or-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dual Enrollment Food Science (4068)</td>
<td>Dual Enrollment Food Science (4068)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
</tr>
</tbody>
</table>

*Earns science credit

**Description**

**Food science** program of study was first implemented with the 2014-15 school year. It focuses on the knowledge and skills needed for careers in the growing fields of food science and technology. Course content includes topics associated with plant and animal production with advanced courses exploring food safety and sanitation, foodborne pathogens, food-related standards and regulations, characteristics and properties of food products, processing and grading techniques and skills, and food labeling and packaging. Upon completion of this program of study, students will be equipped with the technical knowledge and skills necessary for postsecondary or career opportunities in many food science-related fields.

Students can gain job experience while in high school through *supervised agricultural experience* (SAE) program or *work-based learning*. Supervised agricultural experience is a structured experiential learning opportunity for agriculture, food, and natural resources students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.

**Job Outlook**

Implementation of the *Governor's Rural Challenge: A 10-Year Strategic Plan* focuses on growth and prosperity of agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skillsets for agricultural jobs are more complex and have an increased focus on technology.\(^1\)

Tennessee’s robust agricultural production alone, excluding forest products, generates approximately $2.5 billion annually in farm cash receipts.\(^2\) The agro-forestry industry employed over 363,500 people or 10.3 percent of the

---


state's total workers. This economic and employment impact provides the justification for the need for skilled workers within the food science program of study to maintain safety and the wholesomeness of animal and plant food products, reducing the public's risk of contracting food borne illnesses.

Tennessee has a robust agricultural industry that supplies vendors and products around the globe. This strong agricultural economy accounts for 10.5 percent of Tennessee's economy while generating over $51.4 billion in output. This has been the results of quality well known food brands such as M&M Mars, Bush Beans, Moon Pies, Tyson Foods, Coca-Cola, Green Mountain Coffee, and Unilever. Tennessee is actively supporting growth in the food and beverage sector with plans to develop over 4,000 new jobs.

While the number of large farms continue to decrease, more producers will be growing fresh fruits, vegetables and organic crops located near cities and metropolitan areas. This will drive the demand for a variety of occupations in the areas of soil and plant scientists, food science technicians and inspectors as listed below in Figure 1 with a strong increase in industry related occupations such as certified crop advisors, food production consultants, pest control specialist, and production managers for poultry and swine. Figure 2 shows the distribution of food science technicians while Figure 3 shows a comparison of state and national employment trends.

---

Figure 1. Tennessee employment projections for food science-related occupations with positive job openings projected 2014-24\(^9\)\(^ {10}\)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19-1013 Soil and Plant Scientists</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>1%</td>
<td>$44,040</td>
</tr>
<tr>
<td>19-4011 Food science technicians</td>
<td>520</td>
<td>560</td>
<td>20</td>
<td>7%</td>
<td>$29,670</td>
</tr>
<tr>
<td>25-1041 Agricultural Sciences Teachers, Postsecondary, Food Science and Processing</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>45-2011 Agricultural Inspectors</td>
<td>No Data Available*</td>
<td>No Data Available*</td>
<td>No Data Available*</td>
<td>No Data Available*</td>
<td>$41,910</td>
</tr>
<tr>
<td>51-3021 Butchers and meat cutters</td>
<td>2,750</td>
<td>3,100</td>
<td>350</td>
<td>13%</td>
<td>$28,760</td>
</tr>
<tr>
<td>51-3022 Meat, poultry, and fish cutters and trimmers</td>
<td>3050</td>
<td>3080</td>
<td>40</td>
<td>1%</td>
<td>$21,080</td>
</tr>
</tbody>
</table>

*Data was not available or provided due to confidentiality regulations.


Figure 2. 20124 Estimated Employment for food science technicians.\textsuperscript{11}

![Map showing estimated employment for food science technicians](image)

<table>
<thead>
<tr>
<th>2014 Estimated Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: TN Dept of Labor &amp; Workforce Dev, Div EMP, Div EMP, UHL</td>
</tr>
</tbody>
</table>

Figure 3. State and national trends for food science technicians for 2014-24.\textsuperscript{12}

<table>
<thead>
<tr>
<th>National</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-4011 Food science technicians</td>
<td>33,000</td>
<td>34,700</td>
<td>5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tennessee</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-4011 Food science technicians</td>
<td>520</td>
<td>560</td>
<td>7%</td>
</tr>
</tbody>
</table>


\textsuperscript{12} Career One Stop. (2017). Occupation Profile, State and National Trends. Retrieved from \url{https://www.onetonline.org/link/summary/19-4011.02}
**Postsecondary Pathways**

Food science program of study provides a wide range of career opportunities that link to several careers in each of the other agriculture, food, and natural resources program of studies and to multiple postsecondary pathways including food science and technology with options in pre-pharmacy, pre-professional, science concentration, technology, and business in addition to the related degrees of animal science, plant science, and agricultural business. According to a report published by the University of Tennessee, Food Science majors were the highest earning group with a median earning of $65,000.\(^{13}\) Obtaining a graduate degree will provide a 54 percent boost in earnings for Food Science majors earning a Masters or Doctoral degree. **Figure 4** outlines the related career opportunities and the training required for each. While some occupations require a high school diploma the highest paid occupations require a bachelor's or advanced degree.

**Figure 4. Postsecondary Pathways**

---

Current Secondary Outlook

The 2015-16 school year, 10 schools in Tennessee offered courses in the food science program of study during its second year with an enrollment of 300 students, one percent of the AFNR enrollment. Of that group 866 students were enrolled in the Principles of Food Production, the level two course while 66 students enrolled in the Food Science and Safety, level three, course. The capstone course, Advanced Food Science had the lowest enrollment with 15 students. Figure 5 shows the open enrollment, student enrollment, and concentrators from 2013-14 SY to projections for 2016-17 SY. Figure 6 shows the distribution of the food science programs of study.

Figure 5. Open Enrollment Analysis

<table>
<thead>
<tr>
<th>SY</th>
<th>Food Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No Data</td>
</tr>
<tr>
<td>2014-15</td>
<td>7</td>
</tr>
<tr>
<td>2015-16</td>
<td>10</td>
</tr>
<tr>
<td>2016-17</td>
<td>16</td>
</tr>
<tr>
<td>2017-18*</td>
<td>12</td>
</tr>
</tbody>
</table>

*Preliminary data

Student Enrollment

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience (Introduction course for all POSs)</th>
<th>Principles of Food Production</th>
<th>Food Science and Safety</th>
<th>Advanced Food Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>149</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>86</td>
<td>66</td>
<td>15</td>
</tr>
<tr>
<td>2016-17*</td>
<td>17,990</td>
<td>283</td>
<td>30</td>
<td>66</td>
</tr>
</tbody>
</table>

*Preliminary data

Concentrators

<table>
<thead>
<tr>
<th>SY</th>
<th>Food Science Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No Data</td>
</tr>
<tr>
<td>2014-15</td>
<td>17</td>
</tr>
<tr>
<td>2015-16</td>
<td>26</td>
</tr>
</tbody>
</table>

---

**Figure 6.** Distribution of food science programs of study.\(^{17}\)

**Recommendation**
No additional recommendations

<table>
<thead>
<tr>
<th>2018-19 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Science</td>
<td>Agriscience(^1) (5957)</td>
<td>Principles of Food Production (6118)</td>
<td>Food Science and Safety (6115) -or- <strong>Dual Enrollment</strong> Food Science (4068)</td>
<td>Advanced Food Science (6113) -or- <strong>Dual Enrollment</strong> Food Science (4068)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{17}\) Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author's calculation of student enrollment data.
References


# Horticulture Science

**2017-18 Program of Study**

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-or- Statewide Dual Credit Course</td>
<td>-or- Dual Enrollment Horticulture Science (4069)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Introduction to Plant Science (4269)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-or- Dual Enrollment Horticulture Science (4069)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Industry Certification: Commercial Pesticide Certification</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
</tr>
</tbody>
</table>

*Earns science credit

## Description

**Horticulture Science** prepares students for a range of careers in the management of greenhouse operations, horticulture production, landscape design and maintenance, and turf management. Content covered includes principles of plant health, growth, reproduction, and biotechnology, principles of hydroponics and aquaponics, greenhouse structures, growing media, site analysis and planning, principles of design, and plant selection and care techniques. Students earn science credit required for graduation and earn early postsecondary credit while developing the knowledge and skills within the program of study. Upon completion of this program of study, students will be prepared to enter industry-related careers, sit for the Ornamental and Turf Commercial Pesticide License (03), earn the Tennessee Specific Industry Certification, and transition to several horticultural and plant sciences majors at the postsecondary level.

Students can gain job experience while in high school through supervised agricultural experience (SAE) program or work-based learning. Supervised agricultural experience is a structured experiential learning opportunity for agriculture, food, and natural resources students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.
**Job Outlook**

Implementation of the *Governor's Rural Challenge: A 10-Year Strategic Plan* focuses on growth and prosperity of the agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skill sets for agricultural jobs are more complex and have an increased focus on technology.¹

**Figure 1** outlines the wide variety of career opportunities with positive projected growth areas in horticulture science industry. Natural Science Managers tops the list of aligned careers for median salaries while first-line supervisors of landscaping, lawn service, and groundskeeping workers occupations remain strong in total number of projected jobs for this program of study. **Figure 2** shows a higher demand for first-line supervisors of landscaping, lawn service, and groundskeeping workers in the higher populated areas of the state, Memphis, Nashville, Chattanooga, and Knoxville. **Figure 3** provides a state and national employment trends comparison.² ³

**Figure 1.** Tennessee employment projections for horticulture science-related occupations with positive job openings projected 2014-24.⁴ ⁵

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11-9121 Natural Sciences Managers</td>
<td>510</td>
<td>530</td>
<td>10</td>
<td>5%</td>
<td>$103,440</td>
</tr>
<tr>
<td>17-1012 Landscape Architects</td>
<td>Data Not Available*</td>
<td>Data Not Available*</td>
<td>Data Not Available*</td>
<td>Data Not Available*</td>
<td>$84,770</td>
</tr>
<tr>
<td>19-1013 Soil and Plant Scientists</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>1%</td>
<td>$44,040</td>
</tr>
<tr>
<td>25-1041 Agricultural Sciences Teachers, Postsecondary – Plant &amp; Soil Science, Horticulture</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>25-1042 Biological Science Teachers, Postsecondary</td>
<td>1,420</td>
<td>1,770</td>
<td>60</td>
<td>24%</td>
<td>$58,420</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>Occupation</th>
<th>2014 Estimate</th>
<th>2024 Estimate</th>
<th>Change</th>
<th>Percent Change</th>
<th>2014 Median Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-9021 Farm and Home Management Advisors, Crop</td>
<td>150</td>
<td>170</td>
<td>0</td>
<td>15%</td>
<td>$42,790</td>
</tr>
<tr>
<td>37-1012 First-Line supervisors of landscaping, lawn service, and groundskeeping workers</td>
<td>4,400</td>
<td>4,670</td>
<td>280</td>
<td>6%</td>
<td>$38,860</td>
</tr>
<tr>
<td>37-3011 Landscaping and groundskeeping workers</td>
<td>20,430</td>
<td>22,030</td>
<td>1,590</td>
<td>8%</td>
<td>$25,090</td>
</tr>
<tr>
<td>37-2021 Pest Control Workers</td>
<td>2,200</td>
<td>2,400</td>
<td>80</td>
<td>9%</td>
<td>$35,310</td>
</tr>
<tr>
<td>41-1011 First-Line Supervisors of Retail Sales Workers</td>
<td>36,690</td>
<td>38,680</td>
<td>1,000</td>
<td>5%</td>
<td>$36,760</td>
</tr>
</tbody>
</table>

*Data was not available or provided due to confidentiality regulations.

**Figure 2.** 2014 Tennessee employment projections for first-line supervisors of landscaping, lawn service, and groundskeeping workers 2014-24.6

---

Figure 3. State and national trends for first-line supervisors of landscaping, lawn service, and groundskeeping workers for 2014-24.7

<table>
<thead>
<tr>
<th></th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>National</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37-1012 First-Line supervisors of landscaping, lawn service, and groundskeeping workers</td>
<td>178,000</td>
<td>187,400</td>
<td>3,900</td>
</tr>
<tr>
<td><strong>Tennessee</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37-1012 First-Line supervisors of landscaping, lawn service, and groundskeeping workers</td>
<td>4,400</td>
<td>4,670</td>
<td>280</td>
</tr>
</tbody>
</table>

Postsecondary Pathways

Upon completion of this program of study, students will be prepared to pursue further study in a variety of horticulture and plant science degrees at the postsecondary level. Specifically, students will be prepared to major in one or more of the following areas: landscape design and construction, turfgrass science and management, public horticulture, organic production, bioenergy, biotechnology or plant science. Figure 4 outlines the related career opportunities and the training necessary for each. Whereas some occupations require a high school diploma, postsecondary certificate, or a bachelor’s degree. Typically, a landscape architect and most management positions must have at least a four year degree.8

---

7 Career One Stop. (2017). Occupation Profile, State and National Trends. Retrieved from [https://www.onetonline.org/link/summary/37-1012.00](https://www.onetonline.org/link/summary/37-1012.00)
Figure 4. Postsecondary Pathways

High School Horticulture Science Program of Study

CTE & Science Credit
- Agriscience Industry Certification
- TN Specific Industry Certification
- Commercial Pesticide Certification

Early Postsecondary
- Statewide Dual Credit
- Introduction to Plant Science
- CTSO competitive Events
  - FFA

Postsecondary Certificate or Diploma

Agriculture Applications Certificate
- Dyersburg State Community College
- Nashville State Community College
- Walters State Community College

Horticulture Certificate
- Nashville State Community College
- Walters State Community College

Landscape Management Certificate
- Walters State Community College

CTSO competitive Events
- FFA

Associates

A.S. Plant Science
- Jackson State Community College
- Walters State Community College

A.S. Plant and Soil Science
- Cleveland State Community College

A.S. Production Horticulture
- Nashville State Community College
- Walters State Community College

B.S. Horticulture, B.S. Plant Science
- Austin Peay University
- Middle Tennessee State University
- Tennessee State University
- Tennessee Tech University
- University of Tennessee, Knoxville
- University of Tennessee, Martin

Bachelors

- Soil and Plant Scientists ($44,040)
- Landscape Architect ($84,770)
- Agricultural Sciences Teacher, Postsecondary ($91,200)
- Natural Sciences Manager ($103,440)

High School Diploma
- Nursery, Greenhouse Worker ($23,950)

Certificate
- Landscaping and Grounds keeping ($25,090)

Associates
- First-Line Supervisors of Landscaping, Lawn Service ($38,860)

Bachelors
Current Secondary Landscape
In the 2015-16 school year, 129 schools in Tennessee offered course in the program of study of Horticultural Science with a total enrollment of 10,540 students. Of these, 499 students in 37 programs participated in the statewide dual credit Introduction to Plant Science course. This program of study remains the second most popular program of study with 29 percent of all AFNR enrollment. Of this group 1,594 students enrolled in Principles of Plant Science and Hydroculture, level two, 3573 students enrolled in either Greenhouse Management or in the statewide dual credit course, Introduction to Plant Science for the level three course. The capstone course, Landscaping and Turf Science declined in 2015-16, but shows recovery in 2016-17. Figure 5 shows the open enrollment, student enrollment, and concentrators for the horticulture science program of study from 2013-14 SY to projections for 2016-17 SY. Figure 6 shows the distribution of the horticulture science programs of study for the 2015-16 SY.9

Figure 5. Open Enrollment Analysis11

<table>
<thead>
<tr>
<th>SY</th>
<th>Horticulture Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No data</td>
</tr>
<tr>
<td>2014-15</td>
<td>129</td>
</tr>
<tr>
<td>2015-16</td>
<td>129</td>
</tr>
<tr>
<td>2016-17</td>
<td>137</td>
</tr>
<tr>
<td>2017-18*</td>
<td>142</td>
</tr>
</tbody>
</table>

*Preliminary data

Student Enrollment

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience (Introduction course for all POSs)</th>
<th>Principles of Plant Sciences &amp; Hydroculture</th>
<th>Greenhouse Management</th>
<th>Landscaping &amp; Turfgrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>N/A</td>
<td>3237</td>
<td>1839</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>1587</td>
<td>3579</td>
<td>1937</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>1594</td>
<td>3573</td>
<td>1508</td>
</tr>
<tr>
<td>2016-17*</td>
<td>17,990</td>
<td>2054</td>
<td>3754</td>
<td>2239</td>
</tr>
</tbody>
</table>

*Preliminary data

Concentrators

<table>
<thead>
<tr>
<th>SY</th>
<th>Horticulture Science Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>727</td>
</tr>
<tr>
<td>2014-15</td>
<td>678</td>
</tr>
<tr>
<td>2015-16</td>
<td>723</td>
</tr>
</tbody>
</table>

---

Two industry certifications are available thru the horticulture science program of study to help secure employment in high wage, high skill, and/or high demand horticulture careers. The Commercial Pesticide Certification (03) is one of the industry certifications that allows students with a passing score to be hired in supervisory positions. Tennessee Specific Industry Certification in Horticulture will be piloted in the 2017-18 school year to students who have completed all four levels in the horticulture science program of study. This certification will provide certification of the student's knowledge and skills to secure employment and earn credit to be used at the postsecondary level.

---

Recommendation
No additional recommendations.

<table>
<thead>
<tr>
<th>2018-19 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horticulture Science</strong></td>
<td>Agriscience(^1) (5957)</td>
<td>Principles of Plant Science and Hydroculture (6119)</td>
<td>Greenhouse Management (5954) -or- <strong>Statewide Dual Credit Course</strong> Introduction to Plant Science (4269) -or- <strong>Dual Enrollment</strong> Horticulture Science (4069)</td>
<td>Landscaping and Turf Science (5951) -or- <strong>Dual Enrollment</strong> Horticulture Science (4069)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Industry Certification</strong>: Commercial Pesticide Certification (03) TN Specific Industry Certification Horticulture Science (Capstone)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
</tr>
</tbody>
</table>
References


Veterinary and Animal Science

<table>
<thead>
<tr>
<th>2017-18 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinary and Animal Science</td>
<td>Agriscience (5957)</td>
<td>Small Animal Science (5958)</td>
<td>Large Animal Science (6116) -or- Dual Enrollment Veterinary &amp; Animal Science (4065)</td>
<td>Veterinary Science* (5961) -or- Dual Enrollment Veterinary &amp; Animal Science (4065)</td>
</tr>
<tr>
<td>Industry Certification: TN Specific Industry Certification Animal Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Earns science credit

**Description**

**Veterinary and animal science** program prepares students for a range of careers in veterinary sciences, vet tech, or pursuing a variety of scientific, health, or agriculture professions. Course content emphasizes, principles of health and disease, basic animal care and nursing, clinical and laboratory procedures, animal ethics, genetics, and the anatomical/physiological systems of a range of small and large animals. Upon completion of this program of study, students will be prepared for entry level animal science occupations or pursue further study in veterinary and animal science degrees at the postsecondary level. Students passing the capstone certification will be awarded the Tennessee Specific Industry Certification for Animal Science and earn postsecondary credit.

Students can gain job experience while in high school through **supervised agricultural experience (SAE)** program or **work-based learning**. Supervised agricultural experience is a structured experiential learning opportunity for agriculture, food, and natural resources students that takes place in a setting outside of regular school hours. This allows students to experience the diversity of agriculture, food, and natural resources industries and to gain exposure to agricultural-related career pathways.
Job Outlook

Implementation of the Governor's Rural Challenge: A 10-Year Strategic Plan focuses on growth and prosperity of the agriculture and forestry industry over the next decade. Education and workforce preparedness were the two major focus areas addressed by the strategic plan. The skillsets for agricultural jobs are more complex and have an increased focus on technology.¹

Colleges of Veterinary Medicine are expected to graduate more students than the demand over the next five years, but not enough will be working with large animals in rural areas.² The University of Tennessee study on Location of Veterinarians and the Economic Impact of these Veterinary Services to Tennessee’s Economy estimated that 24 counties in Tennessee do not have veterinary services for large/mixed animals.³

According to the Employment Opportunities for College Graduates report from the United States Department of Agriculture, careers in research and development connected with feed and animal-health companies will continue to be strong, especially in poultry, dairy and swine operations⁴, and poultry and swine production managers will be in demand.⁵

There are a wide variety of career opportunities requiring education and training from postsecondary certification to advance degrees. As shown in Figure 1, veterinary technologist and technicians and veterinary health teachers at the postsecondary level have the largest annual percentage employment change of 38 percent. Other top ranking occupations in this program of study include animal trainers, 26 percent, veterinarians and nonfarm animal caretakers and Biology science postsecondary teachers both with an annual average change of 24 percent.⁶ The larger population areas of the state provide stronger employment trends for all veterinary science occupations as reflected in Figure 2 and Figure 3.⁷ ⁸ This trend will continue to increase with population growth.

Figure 1. Tennessee employment projections for veterinary and animal science–related occupations with positive job openings projected 2014-24.⁹ ¹⁰

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11-9121 Natural Sciences Managers, Animal Biology/Zoology/Genetics</td>
<td>510</td>
<td>530</td>
<td>10</td>
<td>5%</td>
<td>$103,440</td>
</tr>
<tr>
<td>25-1041 Agricultural Science Teacher, Postsecondary, Animal/Livestock husbandry/Production/Training</td>
<td>260</td>
<td>290</td>
<td>10</td>
<td>14%</td>
<td>$91,200</td>
</tr>
<tr>
<td>25-1042 Biological Science Teachers, Postsecondary, Zoology/Animal Biology</td>
<td>1,420</td>
<td>1,770</td>
<td>60</td>
<td>24%</td>
<td>$58,420</td>
</tr>
<tr>
<td>25-1071 Health Specialties Teachers, Postsecondary, Veterinary Health</td>
<td>5,100</td>
<td>7,010</td>
<td>2770</td>
<td>38%</td>
<td>$81,690</td>
</tr>
<tr>
<td>25-9021 Farm and Home Management Advisors</td>
<td>150</td>
<td>170</td>
<td>0</td>
<td>15%</td>
<td>$42,790</td>
</tr>
<tr>
<td>29-1131 Veterinarians</td>
<td>1,210</td>
<td>1,440</td>
<td>230</td>
<td>19%</td>
<td>$77,760</td>
</tr>
<tr>
<td>29-2056 Veterinary technologists and technicians</td>
<td>1,620</td>
<td>2,240</td>
<td>620</td>
<td>38%</td>
<td>$58,590</td>
</tr>
<tr>
<td>39-2011 Animal Trainers</td>
<td>230</td>
<td>290</td>
<td>20</td>
<td>26%</td>
<td>$23,740</td>
</tr>
<tr>
<td>39-2021 Nonfarm animal caretakers</td>
<td>3,020</td>
<td>3,730</td>
<td>710</td>
<td>24%</td>
<td>$50,770</td>
</tr>
</tbody>
</table>

Figure 2. 2014 Estimated employment for veterinarians in Tennessee.\textsuperscript{11}

![Figure 2: 2014 Estimated employment for veterinarians in Tennessee](image)

<table>
<thead>
<tr>
<th>2024 Projected Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 - 80</td>
</tr>
<tr>
<td>81 - 120</td>
</tr>
<tr>
<td>121 - 140</td>
</tr>
<tr>
<td>141 - 160</td>
</tr>
<tr>
<td>181 - 250</td>
</tr>
<tr>
<td>250 - 450</td>
</tr>
<tr>
<td>N/A</td>
</tr>
</tbody>
</table>

Figure 3. State and national trends for veterinary and animal science-related occupations with positive projections 2014-2024.\textsuperscript{12, 13}

<table>
<thead>
<tr>
<th>National</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2024</td>
<td></td>
</tr>
<tr>
<td>29-2056 Veterinary technologists and technicians</td>
<td>95,600</td>
<td>113,600</td>
<td>19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tennessee</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Projected Annual Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2024</td>
<td></td>
</tr>
<tr>
<td>29-2056 Veterinary technologists and technicians</td>
<td>1,620</td>
<td>2,240</td>
<td>38%</td>
</tr>
</tbody>
</table>


\textsuperscript{13} National Center for O*NET Development. Agriculture, Food and Natural Resources Career Cluster. O*NET OnLine. (2017). Retrieved from \url{http://www.onetonline.org/find/career?c=1&g=Go}
Postsecondary Pathways
Upon completion of this program of study, students will be prepared to pursue further study in veterinary or a variety of animal sciences degrees at the postsecondary level. Specifically, students will be prepared to major in one or more of the following areas: pre-veterinary medicine, veterinary technician, veterinary assistant, animal production, food science, animal science and biotechnology, and agricultural and extension education. Figure 4 outlines the related career opportunities and the training necessary for each. Whereas some occupations require a high school diploma, postsecondary certificate, several occupations require a bachelor’s or advanced degree. Veterinarians must have a doctorate of veterinary medicine and a state license.

Figure 4. Postsecondary Pathways
Current Secondary Landscape

In the 2015-16 school year, 120 schools in Tennessee offered courses in the veterinary and animal science program of study with 12,485 enrolled in the courses. This program of study has the largest enrollment, 32 percent, of all the Agriculture, Food, and Natural Resources programs. Of that group 3,495 students were enrolled in Small Animal Science, the level two course and steadily decreased through the level four course, Veterinary Science, with 1,714 students. Figure 5 shows the open enrollment, student enrollment, and concentrators from 2013-14 SY to projections for 2016-17 SY. Figure 6 shows the distribution of veterinary and animal science programs of study.

Figure 5. Open Enrollment Analysis

<table>
<thead>
<tr>
<th>SY</th>
<th>Veterinary and Animal Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No data</td>
</tr>
<tr>
<td>2014-15</td>
<td>117</td>
</tr>
<tr>
<td>2015-16</td>
<td>120</td>
</tr>
<tr>
<td>2016-17</td>
<td>132</td>
</tr>
<tr>
<td>2017-18*</td>
<td>141</td>
</tr>
</tbody>
</table>

*Preliminary data

Student Enrollment

<table>
<thead>
<tr>
<th>SY</th>
<th>Agriscience (Introduction course for all POSs)</th>
<th>Small Animal Science</th>
<th>Large Animal Science</th>
<th>Veterinary Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>7,444</td>
<td>2488</td>
<td>N/A</td>
<td>1300</td>
</tr>
<tr>
<td>2014-15</td>
<td>13,665</td>
<td>3493</td>
<td>2898</td>
<td>1430</td>
</tr>
<tr>
<td>2015-16</td>
<td>13,282</td>
<td>3495</td>
<td>3011</td>
<td>1712</td>
</tr>
<tr>
<td>2016-17*</td>
<td>17,990</td>
<td>4157</td>
<td>3475</td>
<td>1984</td>
</tr>
</tbody>
</table>

*Preliminary data

Concentrators

<table>
<thead>
<tr>
<th>SY</th>
<th>Veterinary and Animal Science Concentrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>No Data</td>
</tr>
<tr>
<td>2014-15</td>
<td>1035</td>
</tr>
<tr>
<td>2015-16</td>
<td>1428</td>
</tr>
</tbody>
</table>

Dual enrollment and dual credit opportunities with the Veterinary Science course will help to advance the student’s progress toward a degree or certificate at the postsecondary level. The Tennessee Specific Industry Certification (TSIC) for Animal Science with aligned postsecondary credit was piloted by 16 schools during the 2016-17 school year. This pilot will strengthen the rigor for this program of study.

**Recommendation**
No additional recommendations.

<table>
<thead>
<tr>
<th>2018-19 Program of Study</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinary and Animal Science</td>
<td>Agriscience¹ (5957)</td>
<td>Small Animal Science (5958)</td>
<td>Large Animal Science (6116)</td>
<td>Veterinary Science¹ (5961)</td>
</tr>
<tr>
<td></td>
<td>-or-</td>
<td>-or-</td>
<td>-or-</td>
<td>-or-</td>
</tr>
<tr>
<td></td>
<td>Dual Enrollment</td>
<td>Veterinary &amp; Animal Science (4065)</td>
<td>Dual Enrollment</td>
<td>Veterinary &amp; Animal Science (4065)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Industry Certification:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TN Specific Industry Certification Animal Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supervised Agricultural Experience (5964)</td>
<td></td>
</tr>
</tbody>
</table>

¹ Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author’s calculation of student enrollment data.
References


