**Turfgrass Science Curriculum for Secondary Agriculture Education Programs**

**Curriculum Goals**

* Build a solid foundation in the science and practices of turfgrass management so secondary students can successfully care for a turfgrass surface.
* Introduce students to community, environmental, and economic benefits of turfgrass.
* Introduce students to career opportunities in the turfgrass industry.
* Provide a competitive edge to students interested in pursuing higher education in the turfgrass industry.
* Provide a comprehensive curriculum that can be easily implemented in secondary agriculture education classrooms regardless of teacher experience and background.
* Meet the needs of students and requirements set forth by Pennsylvania Department of Education.

**Curriculum Overview**

The turfgrass science curriculum was developed to provide agriculture educators with lessons that could supplement any secondary plant science curriculum. These units can be used to enhance the plant science curriculum or replace other units in the plant science curriculum. The units should be used as a whole in the order they are presented to provide the most benefit to learners.

The curriculum and associated lessons were set up to provide basic knowledge in the core areas of turfgrass science. An introductory unit with information on careers and community, economic, and environmental benefits starts the curriculum. Unit 2 introduces students to turfgrass plant growth and development, anatomical features, and identification of different turfgrass species. Adaptations of turfgrass species are also covered. Unit 3 assumes students already have a basic understanding of soil science and provides more in-depth information on soil requirements for successful turfgrass growth. Unit 4 addresses all of the major cultural practices necessary for healthy turfgrass growth, including mowing, fertilization, irrigation, aeration, topdressing, and pest control. Unit 5 ties all previous information together with establishment. Successful establishment cannot take place without a firm understanding of turfgrass species and adaptations, soil requirements, and essential cultural practices.

To help achieve the goal of practical application, each lesson is set up for students to learn foundational information, participate in an activity, and review the material. Introductory information is provided in the form of lecture, question and answer, and discussion. Activities are provided in each lesson to allow students to delve more deeply into the information. Activities include hands-on labs, demonstrations, and projects. Many of the activities take place outdoors. Therefore, the best time for the curriculum to be implemented is in late spring (April – June) or early fall (late August – October) when both warm and cool season turfgrass areas are actively growing (Rate of growth is dependent on climatic location). Students are encouraged to interact, collaborate, and discuss the information presented in each lesson. Lessons conclude with a review of the material and question and answer sessions between students and the teacher.

The total length of the curriculum is twenty seven days, but can easily be lengthened with the use of optional activities. Each lesson is planned for a 50 minute class period. The curriculum is meant to build from day one to the final day. Each day students learn additional information that builds an overview of management for successful turfgrass areas. To encourage students to synthesize all of the information learned over the course of the curriculum, two options for a final, culminating project are provided. One option for the final project is to develop an annual maintenance calendar for a turfgrass area of their choice. The second option could be to direct the entire curriculum toward a community service project such as renovating a local park or community sports field. Both final project options will allow students to practically apply the information they learned throughout the curriculum.

**COMPREHENSIVE OVERVIEW OF LESSONS**

The following is a description of each unit within the curriculum. The lesson name, lesson length, PowerPoint presentation name, lesson objectives, supplemental materials, and optional activities are all listed to provide a better understanding of what is provided in the proposed turfgrass science secondary education curriculum.

**Unit 1 – Introduction to Turfgrass Science**

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| Lesson | Turfgrass Introduction Lesson |
| Lesson Objectives | 1. Explain how turfgrasses benefit the environment.2. Discuss why turfgrasses are important to the community and economy.3. Identify various careers in the turfgrass industry. |
| Lesson Length | 150 min (broken into three 50 minute class periods) |
| PowerPoint Presentation | Turf Intro PPoint |
| Supplemental Materials | Turfgrass Career Packet - As part of the lesson activity, students will be evaluating job postings (provided by the teacher) for various careers in the turfgrass industry. To guide their evaluation, a Turfgrass Career Packet has been provided for students to record main points. Students will be broken into groups and each group will present the information about their job to the class. This will give students a better understanding of job requirements and qualifications for turfgrass science careers.Job descriptions are provided for commercial, construction, golf course superintendent, lawn technician, research and teaching, and sports turf manager. |

**Unit 2 – Turfgrass Growth and Development, Anatomy, and Identification**

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| Lesson | Turf Anat & ID Lesson |
| Lesson Objectives | 1. Consider what determines a quality stand of turfgrass.2. Explain turfgrass growth and development.3. Properly identify turfgrass anatomical features.4. Use anatomical features to identify turfgrass samples.5. Discuss why turfgrass identification is important.6. Classify turfgrasses according to their use. |
| Lesson Length | 200 min (broken into four 50 minute class periods) |
| PowerPoint Presentation | Turfgrass Anatomy & ID PPoint |
| Supplemental Materials | Turf Plot Observation Form - Students will be observing turfgrass quality and fertilizer effects on different turf plots for 6 weeks. They will record their observations using the Turf Plot Observation Form.OSU Turf ID Publication and Turf Anat & ID Student Packet – These resources can be used to provide guidance with anatomy and identification. Turfgrass Adaptation Activity – Students will identify turfgrass adaptations according to climatic conditions, management level and user needs. As a group they will identify the best turfgrass species for each situation based on their tolerance ranges.Optional activities: Germination activity – Students can plant grass seed to observe germination stages. The activity can take place by placing seeds on a wet paper towel in a Petri dish. Have students observe the germination process and record what is happening during each stage. (Length to prepare seeds – 20 min; Length for germination process – 3-5 days if using perennial ryegrass)Seed identification lesson (Length – one class period)Project – Each student receives a different turfgrass species. Students create a poster that describes identifying characteristics, adaptation, and where the species can be used in turfgrass applications. Information can then be presented to the class. – (Length – take home assignment)Quiz – A quiz has been provided to test students on the material they have learned from Unit 1 and 2. Material includes turfgrass careers, turfgrass benefits, turfgrass anatomy, and turfgrass identification. |

**Unit 3 – Turfgrass Soils**

The turfgrass soils module assumes that students have already received instruction in soils regarding soil formation, soil profiles, soil physical properties, and soil chemistry. If students have not, teachers may want to consider adding introductory soils lessons prior to the turfgrass soil module.

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| Lesson | Soil Lesson |
| Lesson Objectives | 1. Define compaction.2. Identify causes of compaction and areas prone to compaction.3. Make observations about variables that may influence soil compaction.4. Identify soils most commonly associated with compaction.5. Describe how compaction affects maintained turfgrass areas.6. Explain why drainage is crucial for turfgrass areas.7. Explain how compaction and soil texture affects infiltration and percolation.8. Explain different types of drainage. |
| Lesson Length | 200 min (broken into four 50 minute class periods) |
| PowerPoint Presentation | Soil Lesson PPoint (this is for day 3) |
| Supplemental Materials | Soils Lab - For Day 1, students will go outside on school grounds to different locations where they will make observations, collect a soil sample, take a penetrometer reading, and measure infiltration rates. For Day 2, students will determine soil textural class using the Feel Method. Be sure to include Soil Textural Class – The Feel Method handout in the lab materials.Optional activities:Lab report – Students can write a lab report based on the Soil Lab. Instructions are contained within the Soil Lab WS. (Length – take home assignment) |

**Unit 4 – Turfgrass Cultural Practices**

Teaching about turfgrass cultural practices is largely based on visual and hands-on demonstrations. Depending on available resources, certain activities may not be able to take place on school grounds. To enhance student knowledge and understanding, it may beneficial to take a field trip to a golf course or sports field at the completion of Unit 4. Students will be able to see and operate the equipment discussed during Unit 4. Another alternative may be to have a local equipment dealer visit and demonstrate different pieces of equipment on school grounds.

**1 – Mowing**

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| Lesson | Mowing Lesson |
| Lesson Objectives | 1. State why mowing is important to keep turfgrass healthy.2. Compare intended mowing heights for turfgrasses and estimate mowing frequency.3. Identify the different equipment used for mowing turfgrass areas.4. Operate reel and rotary mower safely and correctly. |
| Lesson Length | 50 min  |
| PowerPoint Presentation | Mowing PPoint |
| Optional Activities | Equipment demonstration - If the equipment is available, an equipment demonstration can take place with reel, rotary, and flail mowers. Students can operate the equipment. (Length – 30 min) |

**2 – Fertility**

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| Lesson | Fert Lesson |
| Lesson Objectives | 1. Indicate the importance of soil testing and maintaining a healthy soil pH.2. Name soil macronutrients (N, P, K) and explain their importance for turf growth and health.3. Analyze a fertilizer label.4. Calculate nutrients contained in fertilizer.5. Compare and contrast quick release and slow release nitrogen sources.6. Indicate the importance of calibrating drop and rotary spreaders for fertilization.7. Determine rate and frequency for applying nutrients.8. Operate rotary and drop spreaders safely and accurately.9. Calculate square footage of a turfgrass area.10. Calculate the desired amount of nutrient to apply to the turfgrass area based on the fertilizer grade.11. Calibrate drop and/or rotary spreaders to apply an accurate amount of nutrients to a turf area. |
| Lesson Length | 200 min (broken into four 50 min class periods) |
| PowerPoint Presentation | Fertilization PPoint |
| Supplemental Materials | Fertility In Class Guided Notes - To follow along with the lesson on day 1, students will receive Fertility In Class Guided Notes. Activity - The lesson activity will require students to analyze a fertilizer label (Fert label – starter – 18-24-12). Their answers will be recorded on the Fertility In Class Guided Notes.Calibration Activity – the entire class will work through calibration of a rotary or drop spreader in class to understand the procedure and calculations. Students will then do hands-on calibration of a rotary or drop spreader (this may take 1-2 class periods or 50+ minutes). If a drop spreader is the only available equipment, the Drop Spreader Calibration can be used to adjust the lesson. Homework problems are also provided in the Calibration Activity.Optional activities:Soil Testing – Students may take soil samples from lawn or sports field areas on the school grounds. Samples may be sent to a soil testing lab or county Cooperative Extension for analysis. Soil test results can be provided as part of the lesson to help students decipher how to read a soil report and apply the recommendations. Instructions for proper soil testing are included in the Purdue Soil Testing document. (Length – 30 min)Fertility Homework Questions – questions relating to day 1 of the lesson. Attachments for the homework are Fert label – controlled – 38-3-8 and Fert label – organic – 10-2-8 |

**3 – Irrigation**

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| Lesson | Irrigation Lesson |
| Lesson Objectives | 1. Describe the purposes of irrigation for turfgrass areas.2. Explain turfgrass irrigation requirements.3. Determine irrigation frequency and amount.4. Compare how different soil textures affect water availability.5. Assess sprinkler distribution patterns. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Irrigation PPoint |
| Optional Activities | The class may travel (on or off school grounds) to a site with installed irrigation for students to observe irrigation patterns. As an activity, the class can conduct a water audit to understand water distribution patterns. (Length – 1 class period) |

**4 – Aeration/Topdressing**

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| Lesson | Aeration – Topdressing Lesson |
| Lesson Objectives | 1. Define aeration and explain why it is important for turfgrass areas.2. Recognize the differences in equipment used for aeration.3. Discuss the benefits and disadvantages associated with different aeration practices.4. Define topdressing and explain why it is an effective practice.5. Outline the frequency of an aeration and topdressing program. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Aeration PPoint |
| Optional Activities | Equipment demonstration - If the equipment is available, an equipment demonstration can take place with hollow tine and solid tine aerators and a topdresser (if a topdresser is not available, a rotary spreader can be used to apply topdressing material). Students can operate the equipment. (Length – 30-40 min) |

**5 – Thatch**

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| Lesson | Thatch Lesson |
| Lesson Objectives | 1. Define thatch.2. Identify why thatch is a problem in turf areas as well as how it can be beneficial.3. Discuss ways to manage thatch. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Thatch PPoint |

**6 – IPM**

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| Lesson | IPM Lesson |
| Lesson Objectives | 1. Define Integrated Pest Management (IPM).2. Analyze the steps associated with implementation of a successful IPM program.3. Discuss current legislation surrounding pesticides and IPM. |
| Lesson Length | 50 min |
| PowerPoint Presentation | IPM PPoint |
| Optional Activities | Research IPM Legislation – Students can be assigned (the previous day) to find and read about current IPM legislation in their state or municipality. |

**7 – Weeds**

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| Lesson | Weed Lesson |
| Lesson Objectives | 1. Locate and use resources to assist in proper identification of turfgrass weeds.2. Correctly identify turfgrass weeds.3. Identify different weed control options. |
| Lesson Length | 100 min |
| PowerPoint Presentation | Weed PPoint |
| Activity | Weed ID – the teacher can have live samples already in pots for students to use for identification OR students may go outside and collect 2-3 live weed samples on their own. |

**8 – Insects**

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| Lesson | Insect Lesson |
| Lesson Objectives | 1. Name common turfgrass insect pests.2. Explain insect pest lifecycle and turfgrass damage.3. Identify different insect control options. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Insect PPoint |
| Optional Activities | Insect ID – Instead of teaching about specific turfgrass insects, the teacher could assign common turfgrass insects to student groups. Students can work in their groups to create posters describing the insect, lifecycle, turfgrass damage, and control options. Each group can present their poster to the class. (Length – 2-3 class periods) |

**9 – Diseases**

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| Lesson | Diseases Lesson |
| Lesson Objectives | 1. Describe optimal conditions for turfgrass disease development.2. Recognize diseases common to turfgrass areas.3. Identify different disease control options. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Disease PPoint |
| Supplemental Materials | PSU Managing Turf Diseases Handout – Each student should receive this handout.Optional activities:Disease Case Studies – To challenge students, the teacher may choose to have students diagnose diseases using case studies. (Length – 30-40 minutes) |

**10 – Pesticides**

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| Lesson | Pesticides Lesson |
| Lesson Objectives | 1. Define Personal Protective Equipment (PPE) and recognize related equipment.2. Read a pesticide label.3. Interpret directions and regulations on a pesticide label. |
| Lesson Length | 50 min |
| PowerPoint Presentation | Pesticides PPoint |
| Supplemental Materials | Pesticide Label WS and Pest Label – Confront herbicide - The teacher can guide the class through the worksheet, or students can work alone or in groups on the worksheet. Resources, such as the state pesticide manual and the internet should be available for students to complete the worksheet. If the teacher is leading the class through the worksheet, consider printing the Pest Label as a transparency and using the overhead projector. |

**Unit 5 – Turfgrass Establishment**

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| Lesson | Establishment Lesson |
| Lesson Objectives | 1. Describe each step associated with turfgrass establishment.2. Determine which grasses are best suited for turfgrass sites.3. Analyze a turfgrass seed label.4. List the cultural practices necessary to prepare and maintain the newly established site. |
| Lesson Length | 100 minutes (broken into two 50 minute class periods) |
| PowerPoint Presentation | Establishment PPoint |
| Final Project | There are a few different options for a final project to tie together the information learned from the turfgrass science curriculum.Report:Students will apply what they have learned by writing a report about yearly care and maintenance of a turf area of their choice. Students will create a maintenance calendar and set it up on a month by month schedule. Directions for this project have been created in the Final Project document.Renovation Project:The entire turfgrass curriculum can be directed at a community service project such as renovating a local park or community sports field. Students earn volunteer hours and apply what they have learned in the turfgrass curriculum. They can make choices about the grass species to be planted, the fertilizer to be applied, and the necessary cultural practices needed to maintain the area. Local businesses can be enlisted to donate materials and equipment to help project completion. The project will benefit students, participating businesses, the community, and the agriculture department. |

**Equipment and Resources**

An equipment and resources list has been provided so educators are aware of the necessary equipment needed to carry out lessons successfully. Although some of the equipment is listed as optional in the lesson plans, the equipment is highly recommended for use to provide the most benefit to students.

The following can be obtained from a local home improvement or lawn and garden store, the school maintenance department, or a local equipment dealer:

Reel mower

Rotary mower

Flail mower

Drop and/or rotary fertilizer spreader

Hollow tine and/or solid tine aerator

Topdresser or rotary fertilizer spreader

The following can be obtained online:

Penetrometer - <http://www.turf-tec.com/PNlit.html>

Infiltration rings - <http://www.ams-samplers.com/itemgroup.cfm?CNum=222&catCNum=42>

Soil testing materials - <http://www.aasl.psu.edu/SSFT.HTM>

Petri dishes - <http://www.amazon.com/b?ie=UTF8&node=318074011>

The following can be obtained from a local grocery store, home improvement store, or lawn and garden store:

Fertilizer product – quick release, slow release, controlled release products

Leaf rakes

Rain gauges

Soil probes

Plant pots

Potting soil

Trowel shovels

Rubber mallet

Personal protective equipment – biohazard suit, rubber boots, rubber gloves, goggles, rubber hat, respirator

Flags or aerosol turf paint

Tape measure

Scale – used to weigh small amounts (ounces)

Buckets

Calculators

Shallow cake pans – 8x8x2

Plastic sandwich bags

Labels

Mason jars with lids

Hand lenses

Grass seed

Paper towels

Ruler

Poster board

Classroom equipment (if the classroom does not have PowerPoint or internet capabilities, the lessons are able to be adapted):

Computer

Projector

Screen

PowerPoint capability

Internet access

Chalkboard/whiteboard

Chalk/dry erase markers

Notebooks

Writing utensils

Print outs of lesson materials