The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the turf specialists occupation. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Four duties are broken down into a number of tasks and for each task a table is presented, showing: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety—hazard; science; math—number systems; and communications. The duties include: planting, growing, and maintaining turf for permanent cover and for sod production; selling sod; and maintaining tools, equipment, and structures. Appended is an outline of basic arithmetic skills and concepts needed. (BP)
TURF SPECIALIST
AN ANALYSIS OF THE TURF SPECIALIST OCCUPATION

Developed By

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Occupational Analysis
E.P.D.A. Sub Project 73402
June 1, 1973 to December 30, 1974
Director: Tom L. Hindes
Coordinator: William L. Ashley

The Instructional Materials Laboratory
Trade and Industrial Education
The Ohio State University
"The activity which is the subject of this report was supported in whole or in part by the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions that are expressed herein do not reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred."
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The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics, and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one involved the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of conducting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis included a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills of mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures, as well as identifying specific supporting skills and knowledge in the academic subject areas.
PREFACE

This occupational analysis covers those general duties and tasks involving the planting, raising and caring for sod and turf. A turf specialist may be involved in very specialized operations such as caring for the turf on a golf course, lawn tennis court or other recreation area; or be involved in raising turf for private lawns, public areas, or other contracted areas. This analysis takes a more general approach, covering basic duties and tasks performed by most turf specialists. A small number of specialized tasks are included, but no supervisory tasks are included.
ACKNOWLEDGMENT

We wish to acknowledge the valuable assistance rendered by the following subject matter specialists. They provided input to the vocational instructors in identifying related skills and concepts of each respective subject matter area and served as training assistants in the analysis process during the two-week workshops.

Rollin M. Barber, Psychology
The Ohio State University
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Columbus, Ohio

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Avon Lake, Ohio

Rick Fien, Chemistry
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Beachwood, Ohio

N. S. Gidwani, Chemistry
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Columbus, Ohio

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Donald L. Hyatt, Physics
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Worthington, Ohio

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Jerry McDonald, Physical Sciences
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Columbus, Ohio

David Porteous, Communications
University of Connecticut
Colchester, Connecticut

James A. Sherlock, Communications
Columbus Technical Institute
Columbus, Ohio

Jim VanArsdall, Mathematics
Worthington High School
Worthington, Ohio

Lillian Yontz, Biology
The Ohio State University
Caldwell, Ohio
The following individual is acknowledged for organizational assistance in identifying and coordinating the vocational instructors and consultants in Agriculture Education.

Dr. Wayne Asche  
Teacher Education  
Kent State University  
Kent, Ohio

Acknowledgment is extended to the following I.M.L. staff members for their role in conducting the workshops; editing, revising, proofing and typing the analyses.

<table>
<thead>
<tr>
<th>Faith Justice</th>
<th>Research Associate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheila Nelson</td>
<td>Administrative Assistant</td>
</tr>
<tr>
<td>Marsha Opritza</td>
<td>Editorial Consultant</td>
</tr>
<tr>
<td>Rita Buccilla</td>
<td>Typist</td>
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<tr>
<td>Peg Bushelman</td>
<td>Typist</td>
</tr>
<tr>
<td>Carol Fausnaugh</td>
<td>Typist</td>
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<tr>
<td>Mindy Fausnaugh</td>
<td>Typist</td>
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<tr>
<td>Rita Hastings</td>
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<td>Carol Hicks</td>
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<td>Sue Holsinger</td>
<td>Typist</td>
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<td>Barbara Hughes</td>
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<td>Carol Marvin</td>
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<td>Patti Nye</td>
<td>Typist</td>
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<tr>
<td>Kathy Roediger</td>
<td>Typist</td>
</tr>
<tr>
<td>Mary Salay</td>
<td>Typist</td>
</tr>
</tbody>
</table>
The turf specialist must be able to perform all duties connected with establishing, installing, maintaining, producing or selling turfgrass. The turf specialist must have a basic knowledge of soil properties and characteristics; turfgrass classification, anatomy, physiology and pathology; and must be able to design turf areas according to intended use. The turf specialist must be able to supervise operations such as turf establishment, maintenance and sales. Ultimately the turf specialist should have insight into the problems of management, such as labor management, records, inventory and planning future business expansion and operations.
Duty A  Planting and Growing Turf for Permanent Cover and for Sod Production

1  Measure area and mark boundaries
2  Remove unwanted trees and obstacles
3  Design turf areas
4  Install drainage systems
5  Install water and irrigation systems
6  Apply top soil and establish grades
7  Test soil
8  Prepare soil for seed or sod
9  Sterilize soil
10 Apply fertilizer or lime
11 Apply seed or sod
12 Mulch and water seed bed
13 Care for new seedlings or sod
14 Identify and improve physical features of soil
15 Test soil and improve soil fertility
16 Locate sources and determine availability of commercial fertilizers
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring tape</td>
<td>Use measuring tape to measure length and widths</td>
<td></td>
</tr>
<tr>
<td>Measuring wheel</td>
<td>Use measuring wheel to measure length and widths</td>
<td></td>
</tr>
<tr>
<td>Marking stakes, driving hammer</td>
<td>Figure square feet, yards</td>
<td></td>
</tr>
<tr>
<td>Drawing paper</td>
<td>Post measurements in logical sequence</td>
<td></td>
</tr>
<tr>
<td>Pencils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion tables for measurements of length, area and volume</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH - NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Arithmetic Skills and Concepts (see appendix)</td>
<td>Measures of length</td>
<td>Write measurements in logical order</td>
</tr>
<tr>
<td>Measures of length</td>
<td>Determination of areas</td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**

- Implied—application of procedure

**CUES**

**ERRORS**

- Incorrect marking
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree saws</td>
<td>Cut tree with hand and power chain saws</td>
<td>Hazards</td>
</tr>
<tr>
<td>Chain saw</td>
<td>Cut root system with axe</td>
<td>Injury from saws, shovel or axe</td>
</tr>
<tr>
<td>Shovel</td>
<td>Load cut wood into truck</td>
<td>Injury from tractor, equipment or truck</td>
</tr>
<tr>
<td>Axe</td>
<td>Operate tractor with front end loader and back hoe</td>
<td>Injury from falling debris</td>
</tr>
<tr>
<td>Tractor with front end loader and back hoe</td>
<td>Climb and prune trees</td>
<td>Safety precautions:</td>
</tr>
<tr>
<td>Truck</td>
<td></td>
<td>- Wear protective clothing, hard hats and goggles</td>
</tr>
<tr>
<td>Tree harness</td>
<td></td>
<td>- Do not operate equipment when people are near</td>
</tr>
<tr>
<td>Tree rope</td>
<td></td>
<td>- Stand safely back from trees and equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine which to remove</td>
<td>Aesthetics, logic</td>
<td>Removal of wrong object</td>
</tr>
<tr>
<td>Determine how to remove</td>
<td>Size, location, type of object</td>
<td>Injury to objects other than that being removed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple machines used to gain mechanical advantage</td>
</tr>
<tr>
<td>[understand leverage]</td>
</tr>
<tr>
<td>Inertia and momentum (body at rest and body in motion)</td>
</tr>
<tr>
<td>[falling trees]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATH – NUMBER SYSTEMS</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark on a map where underground objects may be hidden</td>
</tr>
</tbody>
</table>
### (Task Statement) Design Turf Areas

#### Tools, Equipment, Materials, Objects Acted Upon

- Drawing paper
- Drawing pencils and pens
- T-square
- Drawing board
- Eraser
- Blueprints
- Blueprinter

#### Performance Knowledge

- Design facilities as needed for demand of golf and other games played on turf
- Make landscape drawings according to various scales
- Write specifications for drainage systems, water lines, electrical lines, sewer lines and golf greens
- Make topographical maps showing elevations

#### Safety - Hazard

#### Decisions

- Determine facilities needed

#### Cues

- Effect of play on grass
- Rules of game

#### Errors

- Inefficient design

#### Science

- Effect of heating and cooling on expansion of materials (change of dimensions)
- Form, balance, scale, proportion, contrast, unity

#### Math - Number Systems

- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Understanding and use of the Pythagorean theorem, based on the right triangle \( a^2 + b^2 = c^2 \)
- Use of formula to determine the area of a circle
- Determination of area of triangles
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area, perimeter and diagonals of quadrilaterals
- Determination of area and circumference of circles
- Use of arcs or chords in determining facts about a circle or its parts
- Determination of the area of rings
- Determination of facts involving sectors of a circle
- Determination of areas and perimeter of an ellipse
- Determination of facts involving lines tangent to circles
- Determination of altitude, area and volume of a right circular cone
- Determination of lateral area, total area and volume of frustums of pyramids and cones
- Determination of the surface and volume of a sphere
- Geometric constructions
- Read and interpret tables, charts and/or graphs
- Measure with the Metric and English system and convert between them

#### Communications

- Write specifications for items described under performance knowledge
- Draw landscape plans
# Task Statement
INSTALL DRAINAGE SYSTEMS

## Tools, Equipment, Materials, Objects Acted Upon
- Transit
- Tile (plastic, clay, etc.)
- Trenching machine
- Ditching equipment
- Gravel
- Tile joint covers
- Tile outlets
- Landscape plans, drawings of drainage system

## Performance Knowledge
- Determine the drainage practices used for different types of turf areas
- Prescribe system of tile line arrangement
- Identify kind of tile used for drainage
- Analyze soil and slope for drainage problems
- Use transit for drainage layout
- Read designs for drainage system
- Operate trenching and ditching equipment
- Lay tile into trenches

## Safety - Hazard
- Hazards:
  - Danger to persons working with digging equipment
  - Laying tile irregularly so as to cause water stoppage and tile breaks
- Safety precautions:
  - Avoid getting overly near digging equipment

## Decisions
- Determine tile layout

## Cues
- Type of turf, soil, tile, drainage problems

## Errors
- Inefficient design

## Science
- Water flow rates according to slope
- Effect of heating and cooling on expansion of materials (change of dimensions)
- Effect of heating and cooling on state of matter (change of matter from one form to another)

## Math - Number Systems
- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)

## Communications
- Read engineering specifications and water flow charts
### INSTALL WATER AND IRRIGATION SYSTEMS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit</td>
<td>Select proper kinds of irrigation pipe, connectors and nozzles</td>
<td>Hazards</td>
</tr>
<tr>
<td>Water pipe and connectors</td>
<td>Use transit for irrigation line layout</td>
<td>Dangers to people working with digging equipment</td>
</tr>
<tr>
<td>Trenching machine</td>
<td>Read designs for irrigation system</td>
<td>Laying irrigation pipe irregularly so as not to drain properly</td>
</tr>
<tr>
<td>Time clocks</td>
<td>Operate trenching equipment</td>
<td>Safety precautions:</td>
</tr>
<tr>
<td></td>
<td>Lay water lines and install connectors and nozzles</td>
<td>Avoid close contact with irrigation equipment</td>
</tr>
<tr>
<td></td>
<td>Check water system for drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assemble automatic electrical system</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implied—application of procedure</td>
<td>Type of turf, equipment, soil, climate conditions</td>
<td>Inefficient design</td>
</tr>
<tr>
<td>Determine proper irrigation system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SCIENCE

- Water flow rates in various size pipes
- Effect of heating and cooling on expansion of materials
  (change of dimensions)
- Effect of heating and cooling on state of matter (change of matter from one form to another)

### MATH - NUMBER SYSTEMS

- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Read and interpret tables, charts and/or graphs

### COMMUNICATIONS

- Read specifications for water flow and electrical circuitry
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top soil</td>
<td>Drive dumptruck to haul soil</td>
<td>Potential danger with dumptruck, tractor and blade</td>
</tr>
<tr>
<td>Truck</td>
<td>Operate tractor with grader blade to establish grade</td>
<td></td>
</tr>
<tr>
<td>Tractor with blade</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Decide where to apply topsoil

**CUES**
- Terrain needs; plant needs; future needs

**ERRORS**
- Poor soil quality
- Poor growth conditions

**SCIENCE**
- Knowledge of good topsoil composition

**MATH – NUMBER SYSTEMS**
- Volumetric measurement of soil needed on a given area

**COMMUNICATIONS**
- Viewing slopes
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucabury or Simplex soil test kit</td>
<td>Take soil samples</td>
<td>Hazards:</td>
</tr>
<tr>
<td>Soil sampling tube</td>
<td>Prepare soil samples</td>
<td>Skin burns from soil test materials</td>
</tr>
<tr>
<td>Soil sampling bags or containers</td>
<td>for testing</td>
<td>Safety precautions:</td>
</tr>
<tr>
<td>Kiln drier (optional)</td>
<td>Test soil for soil reaction</td>
<td>Wear rubber gloves when working with caustic chemicals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine need for a soil test</td>
<td>Growth of plants, soil condition observation; time for test (pre-determined)</td>
<td>Poor quality soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor plant growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Erosion and waste of top soil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand solubility of nutrients in water</td>
<td>Measures of length</td>
<td></td>
</tr>
<tr>
<td>Understand soil acidity or alkalinity</td>
<td>Measure of time and speed, (Example: time-seconds, minutes, etc., speed-feet per minute, R.P.M., etc.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measures of temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liquid and dry measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Write soil test results on a record sheet</td>
<td></td>
</tr>
</tbody>
</table>
**TASK STATEMENT**  PREPARE SOIL FOR SEED OR SOD

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor with following equipment.</td>
<td>Remove weeds or existing sod (if needed)</td>
<td>Hazards</td>
</tr>
<tr>
<td>Grader blade</td>
<td>Clean and rake soil surface if overseeding</td>
<td>Injury from tractor and equipment such as disk or rototiller</td>
</tr>
<tr>
<td>Plow</td>
<td>Plow or rototiller soil</td>
<td></td>
</tr>
<tr>
<td>Disk-pulverizer</td>
<td>Disk and pulverize soil surface</td>
<td></td>
</tr>
<tr>
<td>Harrow</td>
<td>Rake to remove rocks and debris</td>
<td>Safety precautions</td>
</tr>
<tr>
<td>Roto-tiller</td>
<td>Level soil with blade</td>
<td>Disengage power from before servicing rototiller or other moving equipment</td>
</tr>
<tr>
<td>Float or drag</td>
<td>Smooth soil with float or drag</td>
<td>Wear goggles, and protective clothing</td>
</tr>
<tr>
<td>Rake</td>
<td>Clean and store equipment after use</td>
<td>Do not smoke near gasoline engines</td>
</tr>
<tr>
<td>Hand tools needed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shovel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sod spade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roto-tiller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk or cultivator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implied–application of procedure</td>
<td></td>
<td>Poor plant growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incorrect preparation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incorrect preparation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand need for pulverization of soil before seeding</td>
<td>Measures of length</td>
<td>Read operating instructions on equipment before using</td>
</tr>
<tr>
<td>Understand problem of compaction on “heavy” soils</td>
<td>Measure of weight</td>
<td></td>
</tr>
<tr>
<td>Work input, work output, friction and efficiency in simple machines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAFETY - HAZARD**

Hazards:
- Injury from tractor and equipment such as disk or rototiller.

Safety precautions:
- Disengage power from before servicing rototiller or other moving equipment.
- Wear goggles, and protective clothing.
- Do not smoke near gasoline engines.
(TASK STATEMENT) STERILIZE SOIL

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil sterilant chemicals</td>
<td>Select proper method of soil sterilization</td>
<td>Hazards:</td>
</tr>
<tr>
<td>Plastic cover</td>
<td>Install protective cover</td>
<td>- Skin burns or inhalation injury from chemicals</td>
</tr>
<tr>
<td>Anchor stakes for plastic</td>
<td>Apply soil sterilizing material</td>
<td>- Stomach injury if ingested</td>
</tr>
<tr>
<td>Steam sterilization equipment (used for small laboratory work only)</td>
<td>Clean and store soil sterilization equipment</td>
<td>Safety precautions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Wear rubber gloves and respirator if required by chemical</td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine need for soil sterilization
- Select proper method of soil sterilization

**CUES**
- Growth of plants, soil condition observation; time for test (pre-determined)
- Area or amount of soil to be sterilized
- Use of soil

**ERRORS**
- Poor quality soil
- Poor plant growth
- Erosion and waste of top soil

**SCIENCE**
- Gas movement within soil
- Principle of sterilization when chemical is in soil solution

**MATH - NUMBER SYSTEMS**
- Measure of temperature
- Measurement, liquid and dry
- Measure of weight
- Ratio and proportion

**COMMUNICATIONS**
- Write records on what technique and time schedule used for administering soil sterilization
### Tools, Equipment, Materials, Objects Acted Upon

<table>
<thead>
<tr>
<th>TRACTOR WITH THE FOLLOWING EQUIPMENT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Fertilizer spreader, 2-wheel</td>
</tr>
<tr>
<td>- Harrow</td>
</tr>
<tr>
<td>- Drag or float</td>
</tr>
<tr>
<td><strong>Hand Equipment:</strong></td>
</tr>
<tr>
<td>- Rake</td>
</tr>
<tr>
<td>- Cyclone-type fertilizer spreader</td>
</tr>
<tr>
<td>- Two-wheel fertilizer spreader</td>
</tr>
</tbody>
</table>

### Performance Knowledge

| INTERPRET RESULTS OF SOIL TEST |
| WORK INTO SOIL WITH HARROW     |
| DRAG OR FLOAT SOIL IN PREPARATION FOR SEEDING |
| CLEAN AND STORE EQUIPMENT AND MATERIALS |

### Safety - Hazard

| **Hazards:** |
| Fertilizer burn to skin, eyes or stomach |
| Injury from tractor or equipment |

| **Safety Precautions:** |
| Use protective clothing and goggles when applying fertilizers |
| Disengage equipment before servicing |

### Decisions

- Determine the need for fertilizer or lime
- Determine what kind of fertilizer or lime needed
- Determine amount of fertilizer or lime needed

### Cues

- Soil observation: previous plant growth
- Soil type, plant type, terrain, season, proposed soil use
- Soil needs, plant needs, weather, manufacturer's suggestions

### Errors

- Incorrect preparation
- Poor plant growth
- Waste of time and money

### Science

- Work input, work output, friction and efficiency in simple machines
- Understand the need for fertilizer or lime in new seeding or sodding
- Understand the proximity of lime and fertilizer materials to seed within seedbed

### Math - Number Systems

- Measures of length
- Liquid and dry measures
- Calculate amount of material need per unit area
- Able to adjust equipment spreading according to need
- Ratio and proportion
- Measures of weight

### Communications

- Record amounts of time or fertilizer applied to a given area
- Read labels three times before using materials
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

<table>
<thead>
<tr>
<th>Tools and Equipment</th>
<th>Performance Knowledge</th>
<th>Safety - Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor with the following equipment: Seeder, two-wheel Seeder, cyclone-type Wagon Rake Stolonizing or hydrofoam equipment (optional)</td>
<td>Apply seed to seed bed uniformly Lay sod Apply plugs, twigs or stolens Rake seedbed lightly after seeding Clean and store equipment and materials</td>
<td>Hazards: Injury due to tractor or equipment Safety precautions: Do not service equipment when in operation Do not smoke around motorized equipment</td>
</tr>
<tr>
<td>Hand tools or equipment Two-wheel seeder Cyclone-type seeder Rake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Grass seed Sod, plugs, sprigs or stolens</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SCIENCE

- Work input, work output, friction and efficiency in simple machines
- Principle of seed contact with soil

### MATH - NUMBER SYSTEMS

- Measures of length
- Liquid and dry measures
- Measure of weight
- Ratio and proportion

### COMMUNICATIONS

- Read seed labels before figuring application rates
- Record amounts of seed, plugs, stolens, etc., applied per unit area
<table>
<thead>
<tr>
<th>PERFORMANCE KNOWLEDGE</th>
<th>TASK STATEMENT: MULCH AND WATER SEED BED</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULCH AND WATER SEED BED</td>
<td></td>
</tr>
<tr>
<td>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</td>
<td></td>
</tr>
<tr>
<td>Tractor</td>
<td>Water tank</td>
</tr>
<tr>
<td>Wagon</td>
<td>Mulches</td>
</tr>
<tr>
<td>Roll (tractor or hand)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine germination time for various seed types</td>
</tr>
<tr>
<td>Apply mulch to seed bed</td>
</tr>
<tr>
<td>Rake mulch evenly</td>
</tr>
<tr>
<td>Roll mulched seed bed</td>
</tr>
<tr>
<td>Water thoroughly</td>
</tr>
<tr>
<td>Clean and store equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect preparation</td>
</tr>
<tr>
<td>Poor quality plants</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazards:</td>
</tr>
<tr>
<td>Injury due to tractor or equipment</td>
</tr>
<tr>
<td>Do not smoke around motorized equipment</td>
</tr>
<tr>
<td>Safety precautions:</td>
</tr>
<tr>
<td>Do not service equipment while it is in operation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type, plant needs</td>
</tr>
<tr>
<td>Soil needs, plant needs</td>
</tr>
<tr>
<td>Soil needs, plant needs, weather, season</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS - CUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select type of mulch needed</td>
</tr>
<tr>
<td>Determine amount of mulch to be applied</td>
</tr>
<tr>
<td>Determine rate and frequency of water to be applied</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record amount of mulch applied</td>
</tr>
<tr>
<td>Record rate, frequency and duration of water applied</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATH - NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures of length</td>
</tr>
<tr>
<td>Liquid and dry measures</td>
</tr>
<tr>
<td>Determination of area and volume of rectangular, cube, and right triangular prisms</td>
</tr>
<tr>
<td>Ratio and proportion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work input, work output, friction, and efficiency in simple machines</td>
</tr>
<tr>
<td>Fluids under pressure</td>
</tr>
<tr>
<td>Principle of water force on soil surface (use fine distribution nozzle when watering)</td>
</tr>
<tr>
<td>Determination of area and volume of rectangular, cube, and right triangular prisms</td>
</tr>
<tr>
<td>Ratio and proportion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECORDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record amount of mulch applied</td>
</tr>
<tr>
<td>Record rate, frequency and duration of water applied</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE - MATH - NUMBER SYSTEMS</th>
</tr>
</thead>
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<tr>
<td>Determination of area and volume of rectangular, cube, and right triangular prisms</td>
</tr>
<tr>
<td>Ratio and proportion</td>
</tr>
</tbody>
</table>
### CARE FOR NEW SEEDLINGS OR SOD

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor or hand mowers</td>
<td>Water turf grass according to need</td>
<td>Hazards,</td>
</tr>
<tr>
<td>Watering hose, tanks and nozzles</td>
<td>Mow new seedlings or sod three or four times before turf</td>
<td>Danger from tractor and mowing equipment</td>
</tr>
<tr>
<td>Watering gauge</td>
<td>grass “maintenance” program begins</td>
<td>Application of weed killers too early</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine frequency, rate and duration of watering for new turf grass</td>
<td>Soil type, plant needs</td>
<td>Poor quality sod</td>
</tr>
<tr>
<td>Determine mowing height and time to mow new seedlings or sod</td>
<td>Soil needs, plant needs, weather, season</td>
<td>Death of seedlings</td>
</tr>
</tbody>
</table>

### SCIENCE
- Work input, work output, friction and efficiency in simple machines
- Development of root and shoot of growing grass plant

### MATH – NUMBER SYSTEMS
- Liquid and dry measures
- Read and interpret tables, charts and/or graphs

### COMMUNICATIONS
- Record watering rate, frequency and duration of new seedlings or soil
- Record times of mowing
(TASK STATEMENT) IDENTIFY AND IMPROVE PHYSICAL FEATURES OF SOIL

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test tubes</td>
<td>Identify components of soil</td>
<td></td>
</tr>
<tr>
<td>Petrie dishes</td>
<td>Apply materials to soils to improve tilth</td>
<td></td>
</tr>
<tr>
<td>Soil amendment materials:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peat moss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sludge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcined clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gypsum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous other materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil sampling tube</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Determine soil type, texture and structure (soil judging)</td>
<td>Observe soil conditions, compare with other known types</td>
<td>Poor quality soil</td>
</tr>
<tr>
<td></td>
<td>Determine means of improving soil structure</td>
<td>Analyze corrective measures available</td>
<td>Poor growth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical and chemical properties of soil.</td>
<td>Liquid and dry measures</td>
<td>Read recommendations for improving soil on the basis of soil judging</td>
</tr>
<tr>
<td>Air</td>
<td>Read and interpret tables, charts and/or graphs</td>
<td>Be able to judge soil and recommend improvement practices</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic matter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineral matter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Task Statement

**Test Soil and Improve Soil Fertility**

**Tools, Equipment, Materials, Objects Acted Upon**

- Soil test kit
- Fertilizers and lime

**Performance Knowledge**

- Conduct soil test for pH, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, iron
- Recommend fertilizer or lime to be used to improve fertility of pH level based on soil test
- Apply needed fertilizer or lime
- Clean and store chemicals and equipment

**Science**

- Availability of nutrients in the soil solution
- Understand pH and how it can be altered

**Math - Number Systems**

- Logarithms
- Measures of temperature
- Liquid and dry measures

**Communication**

- Summarize soil test results and list fertilizer or lime amendments to improve fertility or pH

**Safety - Hazard**

- Hazard: Chemical burn from soil test chemicals or fertilizers
- Safety precautions: Use protective clothes when working with chemicals

**Decisions**

- Implied application of prior knowledge

**Cues**

- Poor plant growth
- Poor plant health
- Unstable soil

**Errors**

- Poor plant growth
- Poor plant health
- Unstable soil
### Task Statement
Locate sources and determine availability of commercial fertilizers.

### Tools, Equipment, Materials, Objects Acted Upon
- Paper
- Pencils
- Calculating machine

### Performance Knowledge
- Identify forms of commercially available fertilizers and lime
- Identify companies which manufacture, supply or distribute fertilizers and lime

### Decisions
- Determine cost and availability of local fertilizers or lime
- Decide which products cost least and insure best results

### Cues
- Correspondence with manufacturers and competitors
- Manufacturer's suggestions, supplier suggestions, previous results

### Errors
- Poor soil quality
- Poor plant growth
- Inefficient use of time and money

### Science
- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Determine cost per unit volume or type of analysis of fertilizer

### Math - Number Systems

### Communications
- Write list of companies, fertilizers and fertilizer costs which would lead to proper decision when ordering fertilizers
Duty B  Maintaining Turf for Permanent Cover and Sod Production

1  Fertilize and lime turf grass
2  Mow turf grass
3  Irrigate turf grass
4  Aerate turf area
5  Remove thatch from turf
6  Pole and brush golf course greens
7  Renovate turf
8  Control weeds in turf
9  Control turf diseases
10 Control insects and other pests in turf
11 Prune trees and shrubs on golf course
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- Types of fertilizer
- Types of lime
- Dry fertilizer spreader—2-wheel
- Dry fertilizer spreader—cyclone type
- Liquid fertilizer proportioner
- Dry fertilizer mixer
- Measuring tape
- Mixing buckets or devices

### PERFORMANCE KNOWLEDGE

- Test soil
- Select proper types of fertilizer applicators
- Measure area to be fertilized
- Interpret rates of fertilizer application
- Apply fertilizer
- Adjust fertilizer applicators to apply determined rate of application
- Clean and store equipment and materials after use

### SAFETY - HAZARD

**Hazards:**
- Chemical burn from fertilizer
- Using dull equipment

**Safety precautions:**
- Use safety eye glasses
- Use rubber gloves
- Read label three times
- Avoid fertilizer contact with skin
- Sharpen equipment properly

### SCIENCE

- Composition of matter, including protons, neutrons, electrons, atoms, molecules, elements
  - [composition of chemical compounds involving nutrients]
- Read and interpret tables, charts and graphs
  - [interpret fertilizer analysis]
- Recognize fertilizer deficiency or excess
- Solubility of chemicals
- Identify and describe major and minor nutrients
- List functions of nutrients in plants

### MATH - NUMBER SYSTEMS

- Basic Arithmetic Skills and Concepts (see appendix)
- Measures of length
- Measures of time and speed, (Example: time-seconds, minutes, etc.; speed-feet per minutes, R.P.M., etc.)
- Measures of weight
- Measures of temperature
- Liquid and dry measures
- Use of formula to determine the area of a circle
- Determination of area of triangles
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area and circumference of circles
- Figure: Area of turf needing fertilization
- Amount of active nutrients in pounds available from commercial farms
- Application rates based on percent of active ingredient used
- Machine settings to accomplish desired distribution rates

### ERRORS

- Wrong type fertilizer applied
- Too much or too little fertilizer used
- Unnecessary application
- Waste of time and money

### CUES

- Soil requirements, plant requirements, ease of application
- Type of fertilizer, soil requirements, plant requirements
- Type of fertilizer, manufacturers' recommendation, soil terrain

### COMMUNICATIONS

- Read fertilizer formulas and tables
- Read orders for application rates from the supervisor
# Mow Turf Grass

## Tools, Equipment, Materials, Objects Acted Upon
- Rotary hand mower
- Reel hand mower
- Reel greens mower
- Verticut mower
- Tractor-drawn rotary mower
- Tractor-drawn gang reel mowers
- Mower blade sharpeners (reel and rotary)
- Lawn sweeper
- Measuring ruler

## Performance Knowledge
- Measure grass height with ruler
- Understand operation of power source, power train and mowing technique
- Service mowing equipment before starting
- Start mower and make running adjustments
- Vary direction of cut according to turf variety and use
- Clean and store mowing equipment

## Safety - Hazard
- Hazards: Vertical, rotary or reel type blades, potentially volatile materials (gasoline, oil and brake fluid)
- Safety precautions: Use safety goggles, insure placement of shields and guards, never service machines while running, operate machines at safe speed, sharpen blades properly, adjust blades properly, avoid smoking around machines

## Decisions
- Determine frequency of mowing various turf varieties
- Determine mowing heights of specific turf varieties

## Cues
- Type of turf, proposed turf uses, weather and growing conditions

## Errors
- Unsightly end turf product
- Growth unstable

## Science
- Simple machines used to gain mechanical advantage
- Centrifugal forces developed by bodies in rotation
- Understand:
  - Physiology of grass plant
  - Cutting action of reel vs. rotary blades
  - Difference between two-cycle and four-cycle engines
  - Fuel mixtures for two-cycle engines
  - Basic transmission systems
  - Leverage
  - Controls
  - Inertia and momentum (body at rest and body in motion)

## Math - Number Systems
- Basic Arithmetic Skills and Concepts (see appendix)
  - Measures of length
  - Measures of time and speed
  - Measures of weight
  - Measures of temperature
  - Liquid and dry measures
  - Development of graphs comparing two complimentary sets of figures
  - Use of fractions and decimals in figuring height of cut and frequency of cut
  - Compute amounts of fertilizer in a source and amount of fertilizer to be applied

## Communications
- Read. Directions for machine operation
- Turf mowing specifications
# Irrigation of Turf Grass

**Task Statement**

Irrigate turf grass

**Tools, Equipment, Materials, Objects Acted Upon**

- Irrigation nozzles, valves, connectors and distributors
- Irrigation hose and various pipes
- Underground irrigation system
- Irrigation water
- Time clock
- Electrical system for automatic watering

**Performance Knowledge**

- Test composition of water
- Calculate water stress on turf types and determine amount of water needed
- Calculate and apply fertilizer or other chemicals in water
- Apply water by hand
- Apply water automatically (adjust automatic system)
- Lubricate and maintain irrigation equipment

**Decisions**

- Select proper watering device
- Determine frequency of watering

**Cues**

- Area to be watered, availability of watering equipment, weather conditions, type of turf
- Weather conditions, soil needs, plant needs, time and equipment availability

**Science**

- Principles of water flow and pressure
- Transpiration principle
- Evaporation principle
- Electrical circuitry
- Water solubility of chemicals
- Physical characteristics of plastic, metal or flexible pipe or hose
- Mechanical action of basic watering nozzles and devices
- Principles of water flow and the pressure

**Math - Number Systems**

- Basic Arithmetic Skills and Concepts (see appendix)
- Measures of length
- Measures of time and speed
- Measures of temperature
- Measures of weight
- Liquid and dry measures
- Use of formula to determine the area of a circle
- Determination of area and circumference of circles
- Calculate:
  - Water flow rates (g.p.m.)
  - Fertilizer proportions in water lines
  - Measuring amount of water applied
  - Measure depth of water penetration

**Communications**

- Read water flow rate charts
- Read fertilizer labels and tables

**Safety - Hazard**

- Hazard: Whiplash action of high pressure lines
- Water pressure directed toward vulnerable human organs
- Drinking treated irrigation water
- Safety precautions:
  - Secure high pressure hoses tightly
  - Do not direct water flow toward people
  - Avoid drinking treated water

**Errors**

- Poor end product
- Waste of time and equipment

**Cues**

- Basic Arithmetic Skills and Concepts (see appendix)
- Measures of length
- Measures of time and speed
- Measures of temperature
- Measures of weight
- Liquid and dry measures
- Use of formula to determine the area of a circle
- Determination of area and circumference of circles
- Calculate:
  - Water flow rates (g.p.m.)
  - Fertilizer proportions in water lines
  - Measuring amount of water applied
  - Measure depth of water penetration
### Task Statement
Aerate Turf Areas

### Tools, Equipment, Materials, Objects Acted Upon
- Mechanical aerifiers—plugging type, slicing type, spiking type
- Dethatching machine
- Thatch
- Hand aerifiers
- Roller
- Plug spreader (drag)

### Performance Knowledge
- Analyze the problems of soil compaction, thatch build-up and lack of soil oxygen
- Service and start dethatching, and aerifying equipment
- Operate dethatching and aerifying equipment
- Operate sod plug roller and spreader equipment
- Clean and store equipment

### Safety - Hazard
- Hazard
  - Cutting hands or feet with equipment
  - Combustion of flammable materials
  - Safety precautions:
    - Use safety toe shoes
    - No smoking around equipment

### Decisions
- Determine type of equipment to use
- Determine frequency of application

### Cues
- Area to be aerated, availability of equipment, weather conditions, type of turf
- Weather conditions; soil needs; plant needs; time and equipment availability

### Errors
- Poor end product
- Waste of time and equipment

### Science
- Simple machines used to gain mechanical advantage (within mechanical aerator)
- Relationship of soil compaction to aeration, percolation of water in soil and root growth

### Math - Number Systems
- Measure of time and speed
- Reach and interpret charts, tables and/or graphs (machine adjustments)

### Communications
- Read instructions on machine operation
### TASK STATEMENT
REMOVE THATCH FROM TURF

#### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- Vertical mower
- Power rake
- Power grass sweeper
- Hand rake

#### PERFORMANCE KNOWLEDGE
- Top dress with soil for simple cases
- Identify causes of thatch accumulation
- Service and start dethatching equipment (vertical mower)
- Operate vertical mower
- Operate hand rake
- Operate hand or power lawn sweeper
- Clean and store equipment

#### SAFETY - HAZARD
- **Hazard:** Danger of vertical mower blades
- **Explosion of volatile materials**
- **Safety precautions:**
  - Wear safety shoes
  - Never service machine while running
  - Do not smoke around machine

#### DECISIONS
- Determine the need for thatch removal
- Determine type of equipment to use
- Determine frequency of dethatching

#### CUES
- Soil requirements, plant requirements
- Area to be dethatched, availability of equipment; weather conditions, type of turf
- Weather conditions, soil needs, plant needs; time and equipment availability

#### ERRORS
- Poor end product
- Waste of time and equipment

#### SCIENCE
- Principles of biological decay of organic matter
- Physical reasons for thatch accumulation
- Principle of vertical rotating blades in removing thatch with a vertical mower

#### MATH - NUMBER SYSTEMS
- Measure of time and speed [determine job time]
- Read and interpret tables, charts and/or graphs

#### COMMUNICATIONS
- Read chart on machine operation
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- Flexible bamboo or steel pole
- Brush type sweeper

### PERFORMANCE KNOWLEDGE
- Operate drag or pole in smoothing bentgrass greens
- Operate hand or power sweeper in smoothing bentgrass greens

### SAFETY – HAZARD
- Hazards:
  - Injury from pole or sweeper
  - Combustion of volatile materials
- Safety precautions:
  - Do not smoke
  - Stand clear of equipment when in operation

### DECISIONS
- Determine frequency of operation

### CUES
- Weather conditions, soil needs, plant needs, time and equipment availability

### ERRORS
- Unsightly greens
- Harm to plants
- Waste of time and money

### SCIENCE
- Reason for worn castings on surface of bentgrass greens
- Principle of rolling or sweeping action in smoothing the green

### MATH – NUMBER SYSTEMS

### COMMUNICATIONS
- Read instructions from supervisor
# Task Statement

## Renovate Turf

### Tools, Equipment, Materials, Objects Acted Upon

- Fertilizer applicator
- Aerifier
- Deckthatcher (vertical mower)
- Seeder (rotary or two-wheel)
- Mulches (peatmoss, straw, etc.)
- Soil sampler
- Soil testing equipment
- Measuring tape
- Fertilizer materials
- Weed killers, insecticides or other pesticides
- Rakes (hand or power)
- Lawn sweeper

### Performance Knowledge

- Analyze causes of poor turf
- Apply weed killers
- Mow turf areas closely
- Mow with vertical mower if thatch is a problem
- Rake severely with tine harrow or power rake
- Remove all debris with sweeper
- Apply lime and fertilizer (test soil first)
- Sow grass seed; drag seed into seed bed, mulch seeding, water seedbed: apply sod, plugs or twigs
- Clean and store equipment

### Decisions

<table>
<thead>
<tr>
<th>Cues</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sod condition, season, time and equipment available</td>
<td>Poor sod</td>
</tr>
<tr>
<td>Sod condition; season; time and equipment available</td>
<td>Unsightly</td>
</tr>
</tbody>
</table>

### Safety - Hazard

- Hazards:
  - Danger to eyes and extremities from power equipment
  - Danger of chemical injury from weed killers
- Safety precautions:
  - Wear eye goggles
  - Wear gloves
  - Stop equipment before servicing
  - Do not smoke around machines

### Science

- Composition of matter, including protons, neutrons, electrons, atoms, molecules, elements
  - [composition of chemical nutrient compounds]
- Read and interpret tables, charts and/or graphs
  - [interpret fertilizer analysis recognize fertilizer deficiency solubility of chemicals]
- Simple machines used to gain mechanical advantage
- Centrifugal forces developed by bodies in rotation
- Inertia and momentum (body at rest and body in motion)

### Mathematics - Number Systems

- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Use of formula to determine the area of a circle
- Determination of area of triangles
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area and circumference of circles
- Development of graphs comparing two complimentary sets of figures

### Communications

- Read fertilizer labels
- Read mixing directions for chemicals
- Read directions for machine operations

### Figure:

- Area of turf needing fertilization
- Amount of active nutrients in particular fertilizers
- Application rates based on active ingredient used
- Machine settings to accomplish desired distribution rates
CONTROL WEEDS IN TURF

**TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON**

- Hand tools for weed removal
- Dry herbicide applicators (2-wheel, cyclone type)
- Liquid herbicide applicators (hand or power sprayers)
- Herbicide materials such as 2,4-D, etc.
- Proportioners and nozzles for water hose end applicators
- Safety equipment for protection

**PERFORMANCE KNOWLEDGE**

- Identify weeds
- Distinguish between annual and perennial weeds and the difference in mechanical or chemical control
- Mix herbicide correctly for proper weed kill
- Service, start and operate equipment
- Apply weed killer for maximum effectiveness
- Use hand tools for mechanical removal of weeds
- Clean and store equipment

**SAFETY – HAZARD**

- Hazards: Chemical burn to skin or eyes
- Improper application rate to result in damaging side effects
- Danger of damage to other plants
- Chemical drift in air or pollution of water or soil
- Safety precautions: Read label three times
- Use protective clothing or respirators
- Apply only in “safe” areas
- Avoid “haphazard” spray or application
- See if chemical can be legally applied

**DECISIONS**

- Determine herbicide type to be used
- Select proper mechanical device for herbicide application
- Determine when herbicide should be applied

**CUES**

- Analyze type of weed to kill, type of sod, type of soil
- Type of herbicide used, manufacturers’ suggested application, soil terrain, season of year
- Season, turf requirements, weed growth

**ERRORS**

- Poor turf quality
- Waste of time and money
- Kill turf

**SCIENCE**

- Fluids under pressure
- Liquid and dry measures
  - [solubility and miscibility of dry and liquid measures]
- Physiological action of weed killer on plants

**MATH – NUMBER SYSTEMS**

- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area, perimeter and diagonals of quadrilaterals (four-sided figures)
- Determination of area and volume of cylinders
- Read and interpret tables, charts and/or graphs
- Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance
- Calculate:
  - Amount of chemical needed per unit volume of water
  - Amount of chemical needed per unit area to be cleaned

**COMMUNICATIONS**

- Read herbicide labels
- Read charts for herbicide rates of application
### Tools, Equipment, Materials, Objects Acted Upon

- Hand lens
- Microscope
- Dry pesticide applicators
- Liquid pesticide applicators (hand sprayers, power sprayers)
- Fungicides and bactericides
- Proportioners and nozzles for hose-end applicators
- Safety equipment for protection

### Performance Knowledge

- Identify turf diseases
- Distinguish between different disease symptoms
- Select preventative disease measures and proper control measures (chemical or mechanical) for a specific disease
- Select proper method of applying fungicide or bactericide
- Select and apply proper seed treatment for preventative measures
- Service, start and operate mechanical equipment
- Clean and store equipment, store chemicals properly

### Safety - Hazard

- Hazards: Chemical burn to skin or eyes
  - Improper application rate or method resulting in damaging side effects
  - Danger of damage to other plants
  - Danger of drift in air or pollution of water or soil
- Safety precautions: Read label three times
  - Use protective clothing or respirators
  - Apply only in "safe" area
  - Avoid haphazard spray or application
  - See if chemical can be legally be applied

### Decisions

- Determine control to be used
- Select proper mechanical device for control application

### Cues

- Analyze type of disease, type of sod, type of soil
- Type of control used, manufacturers' suggested application, soil terrain, season of year

### Errors

- Poor turf quality
- Waste of time and money
- Kill turf

### Science

- Fluids under pressure
- Liquid and dry measures
  - (solubility and miscibility of dry and liquid materials)
  - Physiological action of fungicide or bactericide on disease
- Understand physiology and growth conditions of fungus and bacteria

### Math - Number Systems

- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area, perimeter and diagonals of quadrilaterals (four-sided figures)
- Determination of area and volume of cylinders
- Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance
- Calculate:
  - Amount of chemical needed per unit volume of water
  - Amount of chemical needed per unit volume to be covered

### Communications

- Read labels on chemical materials
- Read charts and tables on mixing and application rates and procedures
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- Hand lens
- Microscope
- Dry pesticide applicators
- Liquid pesticide applicators
- Pesticides
- Proportioners and nozzles for hose-end applicators
- Safety equipment for human protection (goggles, rubber gloves, rubber suit, respirator)
- Insect and pest traps

### PERFORMANCE KNOWLEDGE
- Identify insects and animal pests
- Distinguish between different insect damage
- Select proper control measures for specific pests
- Service, start and operate mechanical pesticide applicator equipment
- Clean and store equipment
- Store chemicals properly

### DECISIONS
- Determine control measures to be used
- Select proper mechanical device for pesticide application

### CUES
- Determine type of pests, type of sod, type of soil
- Type of control used, manufacturers' suggested application, soil terrain, season of year

### ERRORS
- Poor turf quality
- Waste of time and money
- Kill turf

### SCIENCE
- Fluids under pressure
- Liquid and dry measures (solubility and miscibility of dry and liquid chemicals)
- Chemical action of chemical on the pest
- Understand difference between surface and sub-surface pests

### MATH - NUMBER SYSTEMS
- Basic Arithmetic Skills and Concepts (see appendix)
- Basic Measurement Skills and Concepts (see appendix)
- Determination of area, perimeter and diagonals of polygons with more than four sides
- Determination of area, perimeter and diagonals of quadrilaterals (four-sided figures)
- Determination of area and volume of cylinders
- Read and interpret tables, charts and/or graphs
- Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance
- Calculate: Chemical needed per unit volume
  - Amount of chemical to be applied per unit area

### COMMUNICATIONS
- Read labels on chemical materials
- Read charts and tables on mixing and application rates and procedures
# Task Statement

**Prune Trees and Shrubs on Golf Course**

## Tools, Equipment, Materials, Objects Acted Upon

- Trees
- Shrubs
- Hand pruners
- Loppers
- Shears
- Tree harness
- Hard hat
- Tree ropes
- Power saw
- Wood and shrub chipper
- Tree wrap
- Tree paint (tar)
- Saw

## Performance Knowledge

- Identify shrubs and trees needed pruning
- Prune shrubs with hand tools
- Climb trees using tree harness and rope
- Prune trees using hand saws and power saw

## Safety - Hazard

**Hazards:**
- Cuts from pruning equipment
- Danger to eyes
- Danger of falling or of falling objects

**Safety Precautions**
- Use protective goggles and clothing
- Use correct safety harness
- Do not smoke near power saw or other flammable materials

## Decisions

- Determine frequency of pruning
- Determine extent of pruning

## Cues

- Plant needs, growth conditions, season
- Aesthetics, type of plant, growth cycle, season, reason for pruning

## Errors

- Death of tree
- Slow growth

## Science

- Simple machines used to gain mechanical advantage
- Work input, work output, friction and efficiency in simple machines
- Use of leverage with tree ropes

## Math - Number Systems

- View size and shape of tree and/or shrub

## Communications
Duty C  Selling Sod

1. Identify, Recommend and Procure Turf Grass for Specific Uses
2. Sell Sod
3. Harvest, Load and Deliver Sod for Customers
**TASK STATEMENT**
IDENTIFY, RECOMMEND AND PROCURE TURF GRASS FOR SPECIFIC USES

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://example.com/image1.png" alt="Image" /></td>
<td>Identify species and varieties of turf grasses used for turf in Ohio. Identify sources of grass seed, sod, plugs, twigs or stolens. Order quality turf grass seed or sod at economical prices.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select the turf grass needed for specific uses.</td>
<td>Soil conditions, proposed use of grass area, growth conditions, season, weather.</td>
<td>Poor turf quality. Slow growth. Wasted money.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH - NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{TASK STATEMENT} )</td>
<td>( \text{SELL SOD} )</td>
<td>( \text{PERFORMANCE KNOWLEDGE} )</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</strong></td>
<td><strong>DECISIONS</strong></td>
<td><strong>CUES</strong></td>
</tr>
<tr>
<td>Sales invoices</td>
<td>Identify customer needs and desires</td>
<td>Waste of harvest</td>
</tr>
<tr>
<td>Order forms</td>
<td>Take order for sales by telephone</td>
<td>Inefficient use of time, equipment</td>
</tr>
<tr>
<td></td>
<td>Make cost estimates on orders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Write up customer orders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advise customers on establishment and care of sod</td>
<td></td>
</tr>
<tr>
<td><strong>SCIENCE</strong></td>
<td><strong>MATH - NUMBER SKILLS</strong></td>
<td><strong>COMMUNICATIONS</strong></td>
</tr>
<tr>
<td></td>
<td>Basic Arithmetic Skills and Concepts (see appendix)</td>
<td>Take orders by telephone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Make estimates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Write orders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advise customers</td>
</tr>
</tbody>
</table>
**TASK STATEMENT**  HARVEST, LOAD AND DELIVER SOD FOR CUSTOMERS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sod cutter</td>
<td>Lift and roll sod with machine</td>
<td>Hazards.</td>
</tr>
<tr>
<td>Fork lift</td>
<td>Load sod on trucks</td>
<td>back injury to persons loading sod</td>
</tr>
<tr>
<td>Pallets</td>
<td>Deliver sod to customers</td>
<td>Injury from sod cutter, fork lift or truck</td>
</tr>
<tr>
<td>Flat bed truck</td>
<td>Clean and store equipment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implied—application of procedure</td>
<td></td>
<td>Waste of harvest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inefficient use of time, equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH - NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work input, work output, friction and efficiency in simple machines</td>
<td></td>
<td>Read delivery orders</td>
</tr>
</tbody>
</table>
Duty D  Maintaining Tools, Equipment and Structures

1  Clean, paint and sharpen tools
2  Service equipment and vehicles
3  Maintain bridges and buildings
## TASK STATEMENT
CLEAN, PAINT AND SHARPEN TOOLS

### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- Files for sharpening
- Oil squirt cans
- Power grinders or polishers
- Hammer and flyers to straighten tools
- Scrub brushes
- Cleaning rags
- Paints and surfacing materials

### PERFORMANCE KNOWLEDGE
- Identify proper techniques to clean and sharpen working surfaces
- Sharpen tools with hand files
- Sharpen tools with power grinders or polishers
- Identify treatment of specific tools
- Apply painting and surfacing techniques

### SAFETY – HAZARD
- Hazards:
  - Injuries due to careless use of tools
  - Working with tools that are too dull

### DECISIONS
- Determine need and frequency of cleaning and sharpening

### CUES
- Type of equipment; frequency of use, manufacturer’s suggestions, condition of equipment

### ERRORS
- Poorly maintained equipment
- Inefficient use

### SCIENCE
- Centrifugal forces developed by bodies in rotation (grinding wheels)
- Effects of friction on work processes and product quality

### MATH – NUMBER SYSTEMS
- Count and store tools by storage numbers

### COMMUNICATIONS
- Keep tool inventory records
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowers</td>
<td>Determine type of fuel, oil or other material needed to service specific machines</td>
<td>Hazards: Combustion of flammable materials</td>
</tr>
<tr>
<td>Aerifiers</td>
<td>Lubricate, fill gasoline, fill oil chamber and check air in tires</td>
<td>Burning of skin and eyes with chemicals</td>
</tr>
<tr>
<td>Dethatchers</td>
<td>Check electrical system for correct ignition</td>
<td>Danger of improper starts or starts with equipment in gear</td>
</tr>
<tr>
<td>Sprayers</td>
<td>Start and run various equipment to see if in good working order</td>
<td>Safety precautions:</td>
</tr>
<tr>
<td>Tractors</td>
<td>Clean and store equipment</td>
<td>Do not smoke around flammable materials</td>
</tr>
<tr>
<td>Pickups, trucks</td>
<td></td>
<td>Wear protective clothing</td>
</tr>
<tr>
<td>Golf carts</td>
<td></td>
<td>Be sure equipment is disengaged before starting</td>
</tr>
<tr>
<td>Sod cutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power loaders (fork lift)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas and oil cans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grease gun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibrator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine need and frequency of servicing</td>
<td>Type of equipment, frequency of use, manufacturer’s suggestions, condition of equipment</td>
<td>Poorly maintained equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inefficient use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil and gas mixtures</td>
<td>Measures of weight</td>
<td>Read service manuals</td>
</tr>
<tr>
<td>Electrical system firing</td>
<td>Liquid and dry measures</td>
<td></td>
</tr>
<tr>
<td>Simple machines used to gain mechanical advantage</td>
<td>Liquid and volumetric measurements</td>
<td></td>
</tr>
<tr>
<td>Effect of heating and cooling on expansion of materials</td>
<td>Calibrate gap in spark plugs</td>
<td></td>
</tr>
<tr>
<td>(change of dimension)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centrifugal forces developed by bodies in rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</td>
<td>PERFORMANCE KNOWLEDGE</td>
<td>SAFETY – HAZARD</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Scrapers</td>
<td>Identify repairs needed on maintenance buildings or bridges</td>
<td>Hazards</td>
</tr>
<tr>
<td>Paint brushes</td>
<td>Prepare surfaces for painting</td>
<td>Combustion of flammable materials</td>
</tr>
<tr>
<td>Paint, paint thinner</td>
<td>Paint wood or metal surfaces</td>
<td>Injury due to falling from bridges or buildings</td>
</tr>
<tr>
<td>Hammer</td>
<td>Repair wooden or metal structures</td>
<td>Miscellaneous cuts and bruises from hand tools</td>
</tr>
<tr>
<td>Nails, screws, etc.</td>
<td>Reshingle and tar roofs</td>
<td>Safety precautions</td>
</tr>
<tr>
<td>Hand saw</td>
<td></td>
<td>Do not smoke near flammable materials</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td>Use ladders properly</td>
</tr>
<tr>
<td>Bridges</td>
<td></td>
<td>Use hand tools properly</td>
</tr>
<tr>
<td>Roofing shingles and tar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladders</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine need and frequency of maintenance</td>
<td>Type of buildings, etc., frequency of use, condition of buildings, bridges, etc.</td>
<td>Poorly maintained buildings, bridges, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waste of materials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple machines used to gain mechanical advantage</td>
<td>Measures of length</td>
<td>Read paint labels</td>
</tr>
<tr>
<td></td>
<td>Liquid and dry measures</td>
<td>Read directions from the supervisor</td>
</tr>
</tbody>
</table>
Basic Arithmetic Skills and Concepts

Number/numeral/place values
Addition and subtraction of whole numbers
Multiplication and division with whole numbers
Reduction of fractions
Addition and subtraction of proper and improper fractions
Multiplication and division of proper and improper fractions
Changing mixed numbers to improper fractions
Addition and subtraction of decimal fractions
Multiplication and division of decimal fractions
Rounding off decimals and whole numbers
Changing percents to fractions and fractions to percents
Finding a percent of a number and what percent one number is of another
Ratio and proportion
Property of comparison—equality, inequality, greater than/less than

Basic Measurement Skills and Concepts

Measure of length
Measure of time and speed (example: time—seconds, minutes, etc.; speed—feet per minute, R.P.M., etc.)
Measures of weight
Measures of temperature
Liquid and dry measures