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LAND JUDGING AND PLANT NUTRITION, A PROGRAMMED INSTRUCTION UNIT, REPORT NUMBER 13.

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A UNIT OF PROGRAMED LEARNING MATERIALS WAS PRESENTED ON THE PRINCIPLES AND PROCEDURES OF LAND JUDGING AND PLANT NUTRITION. IN HIS PREPARATION, THE AUTHOR FIRST IDENTIFIED PRINCIPLES AND FACTS NECESSARY FOR EFFECTIVE LAND CLASSIFICATION AND PLANT NUTRITION BY EXAMINING RELEVANT SCIENTIFIC REPORTS. USING THIS INFORMATION, HE THEN FORMED A TEAM OF 16 VOCATIONAL AGRICULTURE TEACHERS TO DEVELOP AND TENTATIVELY EVALUATE THE PROGRAMED MATERIALS. THESE TEACHERS WERE ENGAGED IN EXPERIMENTAL USE OF THE MATERIALS AT THE TIME OF REPORTING, AND EVIDENCE OF INSTRUCTIONAL RESULTS WAS NOT THEN AVAILABLE. THIS VOLUME REPRESENTS PART 13 OF A 13-PART FINAL REPORT ON THE VOCATIONAL-TECHNICAL EDUCATION RESEARCH AND DEVELOPMENT PROJECT OF WASHINGTON STATE UNIVERSITY. RELATED VOLUMES ARE ED 010 652 THROUGH ED 010 664. (JH)

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Contract No. OE-5-85-109
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LAND JUDGING AND PLANT NUTRITION
A PROGRAMMED INSTRUCTION UNIT

December 1966

U.S. DEPARTMENT OF
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LAND JUDGING AND PLANT NUTRITION
A PROGRAMMED INSTRUCTION UNIT

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by
Gilbert A. Long

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The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Department of Education, Washington State University, Pullman, Washington, Washington State Board for Vocational Education, Olympia, Washington, Vocational Education Research Coordinating Unit, Olympia, Washington

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INTRODUCTION

Background and Rationale

Effective use of land requires knowledge of its characteristics and the purposes for which it can best be utilized. Proper classification and use of land is essential for efficient production and for conservation. Likewise, knowledge of ways land can be suitably classified is a major factor in determining the profit or loss associated with operation of an agricultural unit.

Research continually provides new information about better means of land classification and utilization. Widespread awareness of that information can help the nation use and conserve its land and increase the incomes of farmers. Agricultural teachers have an obligation to help youth and adults acquire and utilize that information.

Purpose and Objectives

For the above reasons this phase of Project ERD-257-65 work has a two-fold objective. The first is to develop an experimental unit of programmed instruction materials designed to help youth and adults acquire and use knowledge of land-judging principles and procedures. A related objective is to stimulate experimental use of the materials by involving teachers in their development and in experimental use.

These programmed materials are conceived as components of more complete instructional systems that will include reading materials, films, graphics, models, and land-judging practice.

These materials are designed to familiarize students with facts about:

- Why land is classified.
- How land is classified.
- Land classes.
- Factors of classification.
- Effect of pH on plant growth.
- Chemical elements necessary for plant growth:
  - Sources of air, water, and soil.
  - Major and minor elements.
  - Primary plant foods.
  - Secondary plant foods.
- Functions of nitrogen, phosphorus, and potash for growth, maturity, disease resistance.
- Soil amendment to correct acid soil conditions.

Functions of "carrier" materials.
Affect of soil types on fertilizer utilization.
Chemical soil tests.
Soil testing.
The plant processes:
    Photosynthesis.
    Transpiration.
    Respiration.
Physical texture and structure.
Chemical fertility.
Barnyard manure.
Green manure crops.
Commercial fertilizer labeling.
Crop rotation.
The nitrogen cycle.
The solubility of nitrogen.
The carbon-nitrogen ratio.

Related Research

The methodology of teaching through programmed instruction is based upon the principals of stimulus-response psychology. Skinner (5) has researched and written extensively in this area. Smith and Moore (6) have compiled numerous papers which describe much of the leading research in programmed learning.

One valuable feature of programmed instruction is its definition of objectives in behavioral terms. Mager (3) has deliniated the adventages of this technique. Schramm (4), Glazer (2), and others have found that programmed learning materials serve to individualize instruction. They point out that programmed instruction (a) can enlarge opportunity for self-pacing, (b) increase the frequency of meaningful student responses, and (c) facilitate student feedback.

Although programmed instruction may stand alone, it also can be an integral part of instructional systems. DeCecco (1) has compiled research which helps define the unique contribution programmed instruction can make to instructional systems.

A study by Menzel and Katz (8) indicates the extent to which in medicine professional leaders influence adoption of innovations.

Studies by Lewin and Sherif indicate the importance of involving participants in discussion of innovations to be adopted (9).

Christianson's (7) report to the National Seminar on Agricultural Education regarding adoption of educational innovations by

Ohio teachers, found that "the more innovative the experienced teacher was, the greater the degree of opinion leadership which she was likely to hold."

The sixteen agricultural teachers involved in development of these materials and presently assisting with their experimental use represent educational leaders. It is assumed that their participation will speed adoption.

METHOD

The content of this was derived from analysis of facts presented in publications listed in items 10 to 12 in the REFERENCES section of this report.

Pre-test and post-test instruments were designed.

The materials were pilot tested in eight schools and revised. They are presently being used experimentally and further evaluated in sixteen schools. Experimental teachers were oriented to the use of programmed materials and made experimental plans at a 1966 summer workshop conducted as part of the annual Washington Vocational Agriculture Teachers' Conference.

Each experimental teacher sends evaluation results to the Project Coordinator along with pre-test and post-test results. This data will be analyzed and used to further revise the programmed materials.

RESULTS

The experimental programmed instruction materials are reproduced in Appendix A.

DISCUSSION

Development and use of programmed learning devices are still in experimental stages. The author is aware that immediate response to verbal symbols constitutes only one dimension of learning. He views the programmed materials reported here as experimental and as only one component of more adequate instructional systems.

However, as previously noted, involvement of Vocational Agriculture teachers in this Project has stimulated substantial amounts of analytical work and interest in experimentation. Both the author and the teachers involved in the Project were required to reassess cognitive and behavioral objectives. They also made a fresh appraisal of just what knowledges are most essential for effective land-judging practices.

Of equal importance, this effort has aroused interest in development of programmed materials in other areas and in development of more comprehensive systems of instruction.

CONCLUSIONS

Evidence of the instructional values of these programmed materials is not yet available. However, evidence derived from observation of the thought and energy expanded by cooperating teachers indicates that involvement in this type of developmental and experimental enterprise evokes substantial amounts of teacher interest in analytical assessment of objectives and procedures. That evidence implies that continuation and expansion of similar effort is likely to speed development of modernized curricula and more effective instructional materials.

Consequently, we recommend that such effort be expanded and that such work be conceived and pursued as a possible starting point for development of comprehensive instructional systems.

SUMMARY

Principles and facts requisite for effective land classification and plant nutrition practices were identified by examination of recent scientific reports. Utilizing that information, the author involved sixteen Vocational Agriculture teachers in development and experimental use of this unit of programmed learning materials. The teachers are presently (1966-67) engaged in experimental use of the materials. Evidence of instructional results is not yet available. There is substantial evidence that teacher involvement has activated analytical assessment of objectives and interest in innovative instruction.

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Appendix A

PLANT NUTRITION

This is a "Plant Nutrition" programmed instruction unit designed to provide an introduction to "Soil Fertility" or "Plant Nutrition." This program includes the following knowledges:

1. Chemical elements necessary for plant growth, grouped by:
   a. Sources of air, water and soil.
   b. Major and minor elements.
   c. Primary plant foods.
   d. Secondary plant foods.
2. Functions of nitrogen, phosphorus, and potash for growth and maturity of plants and resistance to disease.
3. The soil amendment to correct acid soil conditions.
4. The function of the "carrier" material in commercial fertilizers.
5. The soil type and its affect on fertilizer utilization by crops.
6. The importance of chemical soil tests to establish fertilizer needs.
7. The importance of field testing the rates of fertilizers recommended by the chemical soil test results.
8. The plant processes; photosynthesis, transpiration and respiration.
9. The physical texture and structure and chemical fertility of soils as these two factors limit or promote plant growth.
10. Barnyard manure as a source of nutrients to the soil.
11. Green manure crops.
12. Commercial fertilizer labeling.
13. The purposes of crop rotation.
14. The nitrogen cycle.
15. The solubility of nitrogen.
16. The carbon-nitrogen ratio.

PLANT NUTRITION. Name _____

PRE-TEST

Underline the Correct Answer

1. Water and air furnish three elements for plant growth. They are

   a. Manganese
   b. Phosphoric acid
   c. carbon
   d. oxygen
   e. copper
   f. zinc
   g. hydrogen

2. _____ is taken from the air by certain groups of bacteria. It is available to plants through these bacteria.

   a. Oxygen
   b. Nitrogen
   c. Carbon
   d. Calcium
   e. Phosphorus

3. Which three are known as primary plant foods?

   a. carbon
   b. zinc
   c. nitrogen
   d. phosphoric acid
   e. iron
   f. potash

4. The "rarer elements" include _____, _____, _____, molybdemum, copper, manganese.

   a. zinc
   b. magnesium
   c. boron
   d. iron
   e. nitrogen

5. _____ functions to increase growth and slow up maturity.

   a. Phosphorus
   b. Calcium
   c. Nitrogen
   d. Oxygen

6. _____ hastens maturity of crops.

   a. Nitrogen
   b. Sulphur
   c. Potash
   d. Phosphoric acid

Name _____

7. _____ appears to aid plants in resisting certain diseases.

   a. Phosphorus
   b. Gypsum
   c. Nitrogen
   d. Potash
   e. Phosphoric acid

8. The term _____ is used to indicate the material in which the plant nutrient is found (commercial fertilizers).

   a. dryer
   b. carrier
   c. host
   d. conveyer

9. Lime does not furnish nitrogen, phosphoric acid or potash and is therefore classified as a

   a. carrier
   b. "helper"
   c. fertilizer
   d. amendment

10. Soil acidity is measured as

   a. tilth
   b. friability
   c. sourness
   d. sweetness
   e. pH

11. _____ is the process resulting in production of carbohydrates.

   a. Transpiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

12. _____ is the process of absorption of water by root hairs, movement up through the stems, to the leaves. The remainder of the water is lost by evaporation through the stomata.

   a. Perspiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

13. _____ is a destructive process by which food is destroyed, with a consequent release of energy, intake of oxygen, and outgo of carbon dioxide and water.

   a. Respiration
   b. Exhalation
   c. Transpiration
   d. Photosynthesis

photosynthesis	21. Some knowledge of plant processes are important to the growth and nutrition of crops. Photosynthesis is the process by which green plants combine carbon dioxide and water in the presence of sunlight, to form carbohydrates. _____ results in formation of carbohydrates.
	22. Plants need a certain amount of water in carrying on their physiological processes. However, only a small percentage of the water that is absorbed by the root hairs and passes upward to the leaves is used in these processes. The reminder evaporates through the stomata as water vapor. This process is called transpiration.
Respiration	23. Respiration unlike photosynthesis, which is limited to certain cells in the leaves, takes place in every living cell. Respiration is a destructive process by which food is destroyed with a consequent release of energy intake of oxygen and outgo of carbon dioxide and water. R_____ results in release of carbon dioxide and water.
Transpiration Respiration	24. _____ is the process of absorption of water by the root hairs, and movement up through the stems, to the leaves. _____ is the process involving release of energy, intake of oxygen and outgo of carbon dioxide and water.
Physical texture Chemical fertility	25. Two soil characteristics equally important as limitations to plant growth are the physical texture and structure of the soil and the chemical fertility of the soil. _____ and _____ are important soil characteristics to plant growth.

INFORMATION PANEL

This is a programmed instruction unit for "Plant Nutrition." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Plant Nutrition

If you have not read the information panel, do so now, then proceed to frame 1.

Name _____

1. _____
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23. _____
24. _____
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25. _____
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26. --
27. _____
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28. _____
29. (1) _____
(2) _____
30. --

Plant Nutrition
Continued

Name _____

31. _____
_____
_____

32. _____
_____
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33. --

34. --

35. --

36. _____

37. --

38. _____

39. _____
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40. --

41. _____

42. _____
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43. --

44. --

45. --

46. _____

47. _____

48. --

49. _____

50. _____:_____

51. --

52. _____

53. --

REVIEW

_____
_____
_____

_____ Iron

_____ Copper

_____ Calcium

_____ Boron

_____ Zinc

_____ Sulfur

_____ Molybdenum

_____ Magnesium

_____ Manganese

42. crop residue, green manures, commercial fertilizer, ammonium and nitrate salts by percipitation

crop removal, drainage, erosion, gaseous losses, unavail able forms

carbon hydrogen oxygen	1. Fourteen elements have been recognized as being necessary for plant growth. Three from air and water are carbon, hydrogen, and oxygen. These elements account for over 90 per cent of the total weight of the plant. The three elements furnished by air and water are _____, _____, and _____.
carbon hydrogen oxygen	2. The atmosphere provides c _____, h _____, and 0 _____ to plants.
nitrogen	3. Nitrogen is taken from the air by certain groups of bacteria. The nitrogen assimilated by these organisms undergoes a change before it is used by higher plants. Certain groups of bacteria remove _____ from the air.
nitrogen	4. The bacteria taking nitrogen from the air may be associated with most, if not all, leguminous plants are nitrogen-fixing plants. Non-legumes do not fix _____.
oxygen hydrogen carbon	5. The nitrogen which is taken from the air by bacteria is combined in the soil to make soluble compounds before it can ordinarily be used by higher plants. Therefore, it is ordinarily stated that 7 elements come from the soil, and 3 from air and water. The three from air and water (other than nitrogen) are _____, _____, and _____.

nitrogen phosphoric acid potash	6. Twelve elements are provided by the soil. Nitrogen, phosphoric acid, and potash are known as "primary plant foods" and are needed by plants in relatively large amounts and have long been recognized as those most likely to be deficient in soils. Copy them in the answer space.
calcium sulfur magnesium	7. Calcium, sulfur, and magnesium are secondary plant foods. These secondary plant foods are usually needed in relatively large amounts. Copy in the answer space.
nitrogen phosphoric acid potash calcium sulfur magnesium	8. _____, _____ and _____ are "primary plant foods." _____, _____ and _____ are "secondary plant foods."
iron manganese copper zinc boron molybdenum	9. Iron, manganese, copper, zinc, boron, and molybdenum are usually called the "rarer elements" or "minor plant foods." They are needed in minute amounts but are essential. Copy them in the answer space.
iron manganese copper zinc boron molybdenum	10. Continuing research is studying some eleven other mineral elements. However, _____, _____, _____, _____, _____, and _____, are the "rarer elements" proven to be essential to plant growth.

growth maturity	11. Nitrogen functions to increase growth and defer maturity. It produces a good leaf and stem development and gives to the plant that luxurious dark-green color which is so desirable in growing crops. Nitrogen increases _____ and defers _____.
nitrogen	12. No matter how much phosphoric acid and potash there may be in the soil, the crops can use only quantities in proportion to the growth of the plants, and the growth of the plants will be in proportion to the _____ in the soil.
phosphoric acid	13. Phosphoric acid hastens maturity of crops and aids in transferring substances from the stalk, leaves, and other growing parts to the seed, making the grains plump and full. _____ _____ increases the proportion of grain to straw and also stimulates root development in young plants.
phosphoric acid	14. _____ _____ hastens the maturity of crops. Potash appears to aid the plants resisting certain diseases. An insufficiency of potash results in the early ripening or dying of the stems and leaves of plants while the seeds or fruit are still immature.
potash carbon hydrogen oxygen	15. _____ appears to aid plants in resisting certain diseases. _____, _____, and _____ are elements furnished by air and water. They make up 90 per cent of the plant weight.

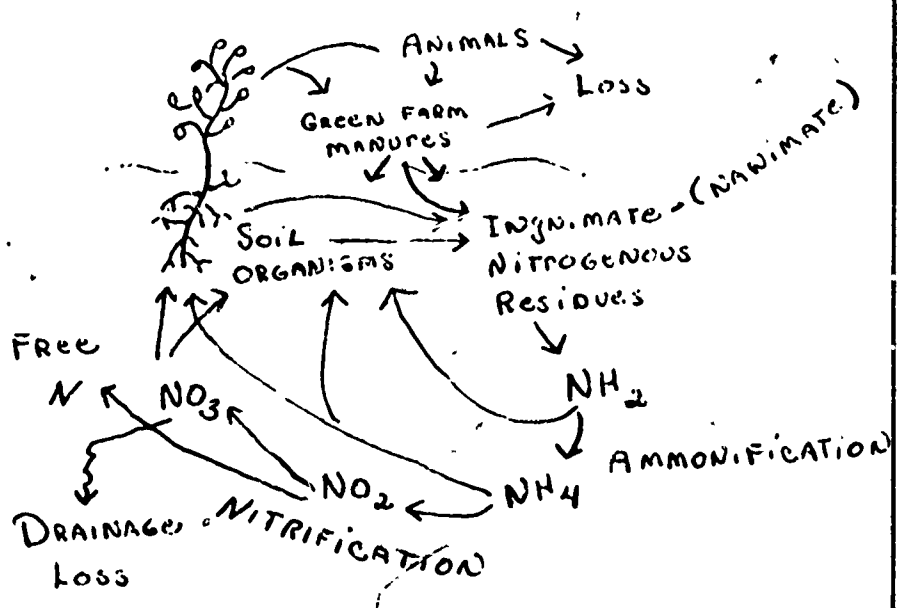
nitrogen potash phosphoric acid	16. The term "carrier" is used to indicate the material in which the plant nutrient is found. For instance, sodium nitrate, superphosphate, and potassium sulfate are carriers of the "primary plant foods," _____, _____, and _____.
carrier	17. The term c_____ is used to indicate the material in which the plant nutrient is found. Chemical soil tests have been developed to determine which fertilizer elements are less than adequate in a particular soil.
less	18. Soil type has a marked effect on the results of fertilizer applied to soils having the same chemical test results. Clay soils are usually richer in plant nutrients than sandy soils. Sandy soils leach badly compared to clay soils, therefore, losing nutrients more quickly than clay soils. Certain chemical forms of a fertilizer elements are more quickly available and are more soluble than other forms. A sandy loam is _____ rich in plant nutrients than a silty clay loam.
clay sandy	19. Chemical soils tests are important to a fertilization program. A field trial based upon the chemical tests results can definitely establish the rate of fertilizer application by applying the amounts of fertilizer indicated by the chemical test to growing crops and by measuring the differences in crop yield. _____ soils do not leach as badly as do _____ soils, and, therefore, do not loose nutrients as quickly.
amendment	20. Lime is called a soil "amendment" rather than a fertilizer, as it does not carry nitrogen, phosphoric acid or potash. The acidity of the soil determines the kinds of crops that can be grown on a soil. Lime is a soil _____.

photosynthesis	21. Some knowledge of plant processes are important to the growth and nutrition of crops. Photosynthesis is the process by which green plants combine carbon dioxide and water in the presence of sunlight, to form carbohydrates. _____ results in formation of carbohydrates.
	22. Plants need a certain amount of water in carrying on their physiological processes. However, only a small percentage of the water that is absorbed by the root hairs and passes upward to the leaves is used in these processes. The reminder evaporates through the stomata as water vapor. This process is called transpiration.
Respiration	23. Respiration unlike photosynthesis, which is limited to certain cells in the leaves, takes place in every living cell. Respiration is a destructive process by which food is destroyed with a consequent release of energy intake of oxygen and outgo of carbon dioxide and water. R_____ results in release of carbon dioxide and water.
Transpiration Respiration	24. _____ is the process of absorption of water by the root hairs, and movement up through the stems, to the leaves. _____ is the process involving release of energy, intake of oxygen and outgo of carbon dioxide and water.
Physical texture Chemical fertility	25. Two soil characteristics equally important as limitations to plant growth are the physical texture and structure of the soil and the chemical fertility of the soil. _____ and _____ are important soil characteristics to plant growth.

	26. Barnyard manure is valuable for its nutrient elements and for its organic matter content so beneficial to the physical structure of the soil. Manure is not a well-balanced fertilizer. It is low in phosphoric acid and relatively high in nitrogen and potash. Addition of phosphorous to manure adds much to its value.
organic matter phosphoric acid	27. Barnyard manure is valuable for its nutrient elements and for its o_____ m_____ content. Manure is low in _____.
green manure crop	28. A green manure crop is one used for turning into the soil, whether planted for that purpose or not. For supplying organic matter to the soil, the g_____ _____ _____ that will produce the most growth in the time available should be chosen.
(1) (2)	29. Fertilizers are made up of two major groups (1) Manures or organic amendments, and (2) Commercial fertilizers. Group I includes barnyard manures, green manures, crop residues and wastes that are plowed under for enrichment of the soil. Group II includes fertilizers produced commercially and sold singularly or in combination. A compost of leaves is [(1), or (2)]. Calcium nitrate is group _____.
	30. The mixed fertilizers are commonly referred to by a series of numbers such as 0 - 10 - 10, 5 - 10 - 20, etc. The first number stands for the percentage of nitrogen; the second number, available phosphoric acid; and the third number, the water soluble potash. 10 - 20 - 30 stands for 10 lbs. of nitrogen, 20 lbs. of phosphate, and 30 lbs. of potash in a 100 lb. sack

15 40 10	31. 10 - 40 - 15 stands for _____ lbs. potash, _____ lbs. phosphoric acid, and _____ lbs. nitrogen. Assume a 100# container.
nitrogen phosphorus potash	32. 20 - 10 - 5 stands for 20 lbs. _____, 10 lbs. _____, and 5 lbs. _____. Assume a 100 # container.
	33. A crop rotation is any plan that is followed whereby one crop follows another. Usually one thinks of a well-planned program when referring to a crop rotation.
	34. Some advantages of crop rotation are: 1. Maintains fertility of the soil. The same crop grown successively uses more of one nutrient than of the others. 2. Disease, weeds and insects are more easily controlled. 3. Labor is distributed to better advantage. 4. Legumes aid in maintaining soil fertility through nitrogen fixation. 5. Erosion control is promoted through preservation of organic matter by proper rotation. 6. Diversification spreads the financial risk. The farmer with a variety of crops has hedged against losses.
	35. Can you think of any suggestions why any of the above might be true? List them.

crop rotation	36. A fundamental approach to _____ _____ includes cash crop, cultivated crop, legume or hay crop (poorer quality soils would require more than one year in this last category).
	37. Nitrogen in the soil is soluble and easily lost to drainage. Nitrogen has a rapid effect on plant growth. Such a potent nutrient element should not only be conserved but also regulated. Some of the intake and outgo of nitrogen can be controlled by man; some is beyond man's control
soluble	38. Nitrogen is _____ and easily lost to drainage.
20 12 15	39. The nitrogen income of arable soils is derived from such materials as crop residues, green manures, farm manures, commercial fertilizers, and ammonium and nitrate salts brought down by percipitation. In addition, there is fixation of atmospheric nitrogen. 12 - 20 - 15 stands for _____ lbs of phosphorus _____ lbs of nitrogen _____ lbs of potassium Assume 100# container
	40. The outgo of nitrogen is due to crop removal, to drainage, to erosion, to loss in a gaseous condition, both elemental and ammonia, and to unavailable forms of nitrogen.

nitrogen	41. _____ has a rapid effect on plant growth.
crop residue, green manures, commercial fertilizer, ammonium & nitrate salts by percipitation---- crop removal, drainage, erosion, gaseous losses, unavailable forms	42. One form of nitrogen income is _____. One form of nitrogen outgo is _____.
	43. Much of the nitrogen added to the soil undergoes many transformations before it is removed. NH_4 (ammonium) changes to NO_2 (nitrate). This nitrate form is either appropriated by microorganisms and higher plants, or is removed in drainage or volatilization. And so the cycle goes on and on.
	44. Study the nitrogen cycle. 

income outgo	46. Crop residue is considered nitrogen (outgo, income). Drainage is considered nitrogen (outgo, income).
low	47. A close relationship exists between the organic matter and nitrogen contents of soils. This ratio of carbon to nitrogen in the organic matter of the furrow slice ranges from 8:1 to 15:1. This ratio controls the available nitrogen, total organic matter, and rate of organic decay. The relationship is called the carbon-nitrogen ratio. Green manure crops have a (low or high) ratio of carbon to nitrogen.
	48. Competition for available nitrogen results when residues having a high C:N ratio are added to the soil (straw at 90:1 carbon to nitrogen ratio for example). When a high carbon residue is added to a soil having a narrow C:N ratio, the demand for nitrate nitrogen becomes so great by the microorganisms rapidly decomposing the organic matter that little nitrate nitrogen is available for higher plants. This slows growth of plants.
a	49. A practical example would be the plowing under of wheat straw and planting a crop. Unless the nitrogen content is high the new crop will lack optimum nitrogen for growth. Commercial fertilizer in correct amounts will hasten decomposition of organic matter and release the nitrate nitrogen for the new crop. Moisture often limits the amount of fertilizer useable as a maximum amount. Farmers currently (A. add commercial nitrogen or B. burn stubble) to keep the C:N ratio low for a new growing crop.
30:1	50. 30 parts carbon to 1 part nitrogen is a ratio of _____:_____ carbon to nitrogen.

	51. Western Washington soils react to phosphorous fertilizer by "fixing" about 70 per cent of it into forms not available to plants. Eastern Washington soils do not lose this much nutrient value. More important to the farmer is whether additions of fertilizers result in a profitable increase in production.
field trials	52. The amounts of fertilizer providing the best economic return can best be determined by chemical tests followed by f_____/ t_____.
	53. Farming is applied science. This program illustrates this. A farmer needs to make use of chemical test, resource people, and the scientific method in his farming enterprise.
	REVIEW The Primary plant foods are _____, _____ _____, and _____. Choose the secondary plant foods by placing the letter "S" in front of them and the "rarer elements" by putting an "R" in front of them. _____ iron _____ copper _____ calcium _____ boron _____ zinc _____ sulfur _____ molybdenum _____ magnesium _____ manganese

PLANT NUTRITION Name _____

POST-TEST

Underline the Correct Answer

1. Water and air furnish three elements for plant growth. They are

   a. Manganese
   b. Phosphoric acid
   c. carbon
   d. oxygen
   e. copper
   f. zinc
   g. hydrogen

2. _____ is taken from the air by certain groups of bacteria. It is available to plants through these bacteria.

   a. Oxygen
   b. Nitrogen
   c. Carbon
   d. Calcium
   e. Phosphorus

3. Which three are known as primary plant foods?

   a. carbon
   b. zinc
   c. nitrogen
   d. phosphoric acid
   e. iron
   f. potash

4. The "rarer elements" include _____, _____, _____, molybdenum, copper, manganese.

   a. zinc
   b. magnesium
   c. boron
   d. iron
   e. nitrogen

5. _____ functions to increase growth and slow up maturity.

   a. Phosphorus
   b. Calcium
   c. Nitrogen
   d. Oxygen

6. _____ hastens maturity of crops.

   a. Nitrogen
   b. Sulphur
   c. Potash
   d. Phosphoric acid

Name _____

7. _____ appears to aid plants in resisting certain diseases.

   a. Phosphorus
   b. Gypsum
   c. Nitrogen
   d. Potash
   e. Phosphoric acid

8. The term _____ is used to indicate the material in which the plant nutrient is found (commercial fertilizers).

   a. dryer
   b. carrier
   c. host
   d. conveyer

9. Lime does not furnish nitrogen, phosphoric acid or potash and it therefore classified as a

   a. carrier
   b. "helper"
   c. fertilizer
   d. amendment

10. Soil acidity is measured as

   a. tilth
   b. friability
   c. sourness
   d. sweetness
   e. pH

11. _____ is the process resulting in production of carbohydrates.

   a. Transpiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

12. _____ is the process of absorption of water by root hairs, movement up through the stems, to the leaves. The remainder of the water is lost by evaporation through the stomata

   a. Perspiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

13. _____ is a destructive process by which food is destroyed, with a consequent release of energy, intake of oxygen, and outgo of carbon dioxide and water.

   a. Respiration
   b. Exhalation
   c. Transpiration
   d. Photosynthesis

Name _____

14. Barnyard manure is valuable for its nutrient elements and for its

    a. phosphoric acid
    b. calcium
    c. organic matter
    d. nitrogen

15. 12-15-7 stands for a commercial fertilizer mixture of 12%_____, 15%_____, and 7%_____.

    a. sulfur
    b. phosphoric acid
    c. potash
    d. nitrogen
    e. calcium
    f. sulfur

    (Fill in the blanks with the correct letter)

16. One approach to _____ includes a cash crop, a cultivated crop, and a legume or hay crop.

    a. nitrification
    b. crop rotation
    c. nutrition
    d. a carbon cycle

17. _____ in the soil is soluble and easily lost to drainage.

    a. Phosphoric acid
    b. Sulfur
    c. Potash
    d. Nitrogen

18. Crop residues, commercial fertilizers, and ammonium and nitrate salts by precipitation are forms of

    a. phosphorus
    b. potash
    c. nitrogen
    d. calcium

19. _____ is most readily available and in larger amounts for microorganisms and plant growth.

    a. N, nitrogen
    b. NH_4, ammonium
    c. NO_2, nitrite
    d. NO_3, nitrate

20. The relationship between nitrogen and carbon is called the

    a. nitrogen-carbon ratio
    b. carbon-nitrogen ratio
    c. potash cycle
    d. carbon-nitrogen equivalent

LAND JUDGING

This program is "Land Judging." It is to follow "Plant Nutrition." "Land Judging" is designed to introduce the subject of soil management. This program includes the following knowledges:

1. Why land is classified.

2. How land is classified.

3. What the classifications are.

4. What pH is and its affect on plant growth.

5. What the seven factors of classification are.

LAND Name _____

PRE-TEST

Underline the correct answer(s)

1. Land classes suitable for cultivation are _____, _____, _____ and _____.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

2. Land classes not suitable for cultivation are _____, _____, and _____.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

3. Land slope is defined as the number of feet fall per _____.

   a. 10 feet
   b. 100 feet
   c. 25 feet
   d. 1,000 feet

4. Soil depth is the effective depth that roots and _____ can penetrate the soil.

   a. moisture
   b. a drill
   c. a shallow rooted plant
   d. a post hole digger

5. Soil permeability refers to the rate of movement of _____ and _____ through the soil.

   a. roots
   b. moisture
   c. air
   d. fertilizer

6. Soils that feel "sticky" when moist are _____ textured soils.

   a. loam
   b. silt
   c. medium
   d. fine
   e. coarse

Name _____

7. "Silty" or "Loamy" textured soils are _____.

   a. fine
   b. medium
   c. coarse
   d. heavy

8. _____ is the major influence for rate of water run-off.

   a. Slope
   b. Soil drainage
   c. Permeability
   d. Flexibility

9. Soil _____ refers to how rapidly the land drains after snow melt or heavy rains.

   a. length of life
   b. drainage
   c. permeability
   d. slope

10. Moderate erosion is a loss of top soil between _____ per cent.

   a. 10-20
   b. 15-30
   c. 25-75
   d. 30-60

11. The acidity, or alkalinity (sweetness) of a soil are measured in terms of _____.

   a. pH
   b. bH
   c. sourness
   d. cation exchange

12. Land that can be used regularly for crops in a good rotation but needs intensive treatment and is subject to serve limitations in use for crop land class _____.

   a. I
   b. III
   c. IV
   d. VI

13. Land that is very deep is greater than _____ deep.

   a. 30"
   b. 40"
   c. 50"
   d. 60"

Name _____

14. The individual parts of soil are called soil _____.

    a. conglomerates
    b. clumps
    c. particles
    d. pieces

15. A common example of a soil profile having limiting permeability is one having a heavy layer of _____ in the subsoil.

    a. sand
    b. minerals
    c. clay
    d. nutrients

INFORMATION PANEL

This is a programmed instruction unit for "Land Judging." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Land

If you have not read the information panel, do so now, then proceed to frame 1.

Name _____

1. --
2. c _____
3. c _____
4. _____
5. c _____
6. _____ s
7. d _____
8. _____ or _____
9. _____
10. _____
_____
_____
_____
_____
11. _____
12. _____ or _____
13. _____
14. _____
15. _____
16. _____
17. _____ to _____
18. _____ to _____
19. _____ to _____
_____
20. _____ to _____
_____
_____ to _____
_____ to _____
_____ --- _____ or _____
21. _____
22. _____
23. _____
24. _____ _____
25. _____
26. _____ _____
27. _____
28. s _____ _____ _____
29. _____
_____
_____
30. _____
_____
_____
31. _____

Land
Continued

Name _____

32. _____ and _____

33. c _____

34. _____

35. f _____

36. _____

37. _____

38. m _____

39. _____

40. _____

41. _____

_____

_____

42. _____ - _____

_____ - _____

_____ - _____

43. _____ _____ _____

44. _____

45. _____, _____ and _____

REVIEW

a. _____ b. _____ to _____

c. _____ _____

d. _____ _____ to _____

e. _____ f. _____ and

_____ g. _____

_____, and _____.

h. _____, _____

and _____

46. s _____ p _____

47. _____

48. _____ and _____

49. _____

50. _____

51. _____

52. _____

53. _____

54. _____

55. _____

56. _____

57. _____ _____

58. _____ _____

59. _____ _____

60. _____, _____

and _____.

61. _____

Land
Continued

Name _____

62. _____

63. _____

64. _____

65. _____

66. _____

_____ _____

_____

67. _____

68. _____

69. _____

70. _____

71. _____

72. _____

73. _____ _____

74. _____, _____ _____,

and _____.

75. a. _____

b. _____

c. _____

76. _____

77. _____

_____

_____

_____

_____

_____

78. _____

79. _____

80. _____, s_____,

s_____, _____

81. _____, _____,

_____, _____,

_____, _____

82. _____

_____

_____

_____

_____

_____

_____

83. _____ _____

_____ _____

84. m_____ _____to

_____ _____to

_____to_____

Land
Continued

Name _____

85. _____
_____
_____
_____
_____
_____

86. _____ _____

87. _____ _____

88. _____, _____
_____

89. _____

90. _____

91. _____

92. _____

93. _____

94. _____

95. _____, _____,
and _____.

96. _____

97. _____and_____

98. _____

99. _____to_____
_____and_____.

100. _____to _____

101. _____

102. _____

103. _____ to _____,
_____, or_____.

104. _____
_____
_____ _____

105. _____
_____

106. _____

107. _____

108. _____

109. _____

110. _____and_____

111. _____

112. _____

113. _____

114. _____

115. _____

Land
Continued

Name _____

116. _____

117. _____

118. _____

119. _____

120. _____, _____, _____

121. _____

122. _____

123. _____

124. _____

125. _____

126. _____

127. _____

128. --

129. _____

130. _____

131. --

132. _____

133. --

134. --

135. _____

136. _____

137. _____

138. _____

	1. Before you start the program, you should read the instruction sheet. If you have not already done so, read the instruction sheet now. If you read it, proceed to frame 2.
capability	2. For the most hazard free land usage we classify our soil into "ability to produce" groups, or land capability classes. These eight capability classes are divided according to their c_____.
classify	3. Just as a doctor checks pulse and temperature of a patient before classifying the sickness, so do we learn to check the seven symptoms of our land before attempting to c_____ it.
seven	4. We look for _____ factors or symptoms before classifying the land and recommending certain crop usage for it.
classifying or classification	5. The reason for c_____ of land is to make the best use of the land. We wish to gain the biggest return from our investment without permanent loss of the soil or its fertility.

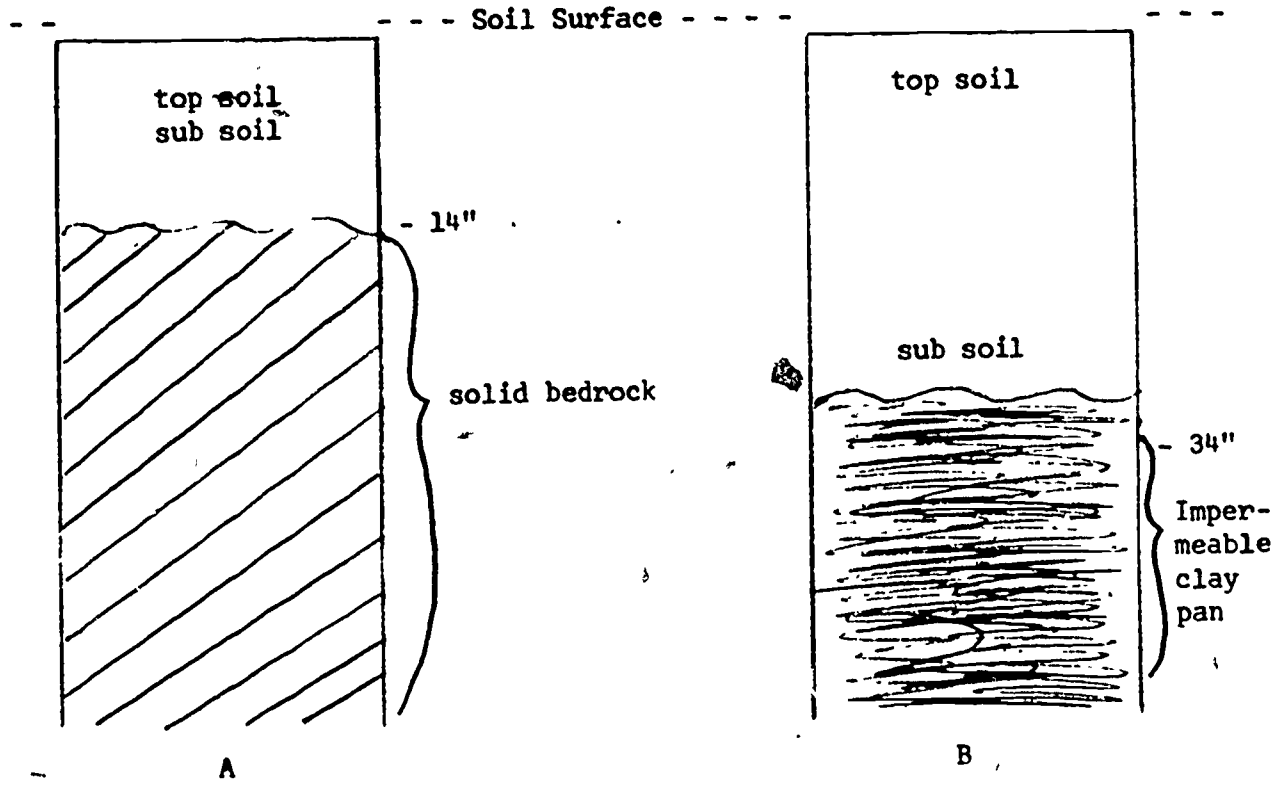
factors or symptoms	6. Efficient classification of the land will require a detailed knowledge of the seven _____s.
depth	7. Soil depth is the first factor we will consider in detail. Soil d_____ is determined by the depth of penetration of roots and moisture.
moisture or root	8. Soil depth may be measured by either _____ or _____ penetration.
soil depth	9. We classify soils as very shallow, shallow, moderately deep, deep or very deep. These are divisions or categories of _____ _____.
	10. Soil depths are separated by inches as follows: 0-10" - very shallow 10-19" - shallow 20-35" - moderately deep 36-59" - deep 60" or more - very deep Copy the soil depths.

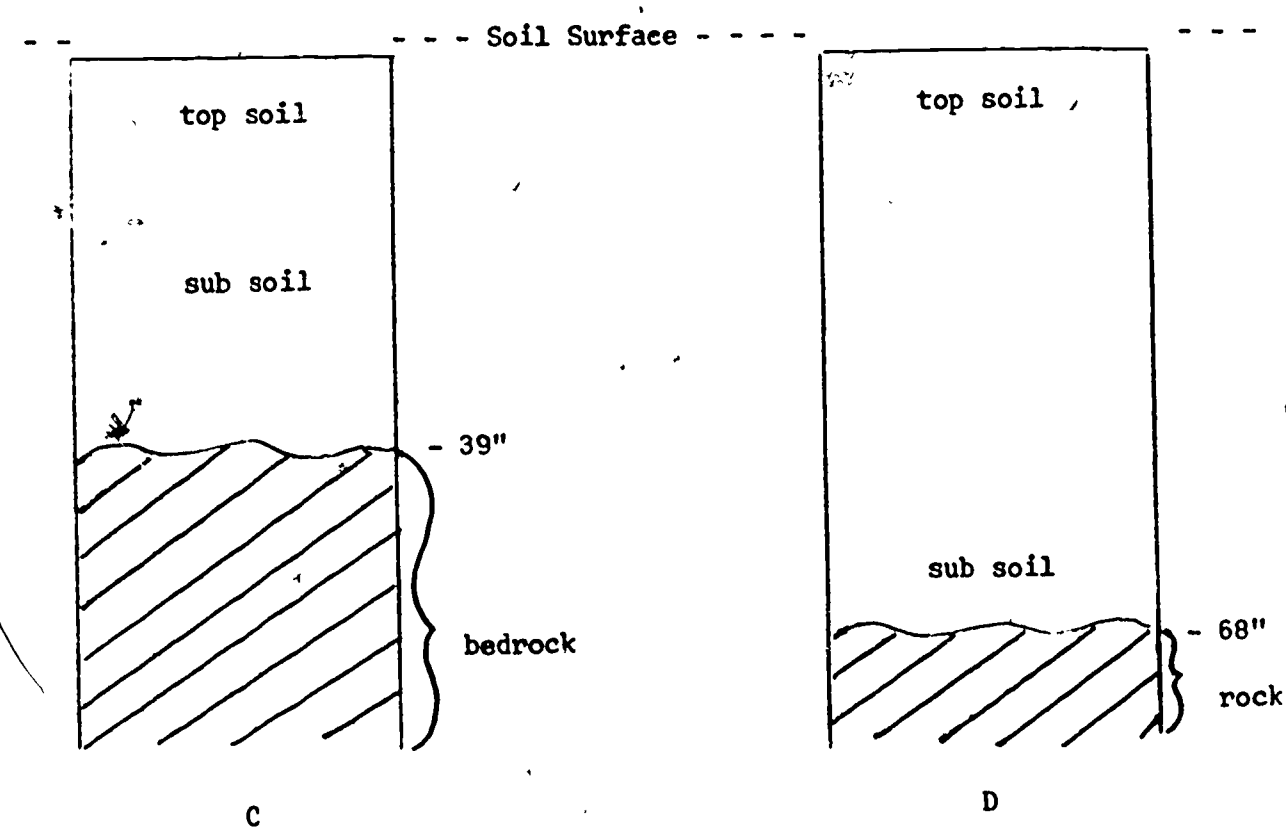
deep	11. Deep soils are from 36-60 inches deep. Alfalfa roots found at 53 inches depth is an indication of a _____ soil.
moisture or roots	12. Very deep soils can be identified by evidence of _____ or _____s at 60 inches or deeper.
10	13. Very shallow soils are less than 10 inches deep. Shallow soils are from _____ to 19 inches deep.
36	14. Moderately deep soils are from 20 to 36 inches deep. Deep soils are from _____ to 60 inches deep.
60	15. Very deep soils are _____ inches or deeper.

10	16. Very shallow soils are less than _____ inches deep.
20 36	17. Moderately deep soils are _____ to _____ inches deep.
10 20	18. Shallow soils are from _____ to _____ inches deep.
36 60 60	19. Deep soils are from _____ to _____ inches deep. Very deep soils are _____ inches deep or more.
0-10 Shallow 20-36 36-60 Very deep -- 60 or over	20. If you answer the following questions correctly, move on to question 21. Otherwise, turn back to question 11 for a review. Very shallow --- ___ to ___ " _____ ---- 10 to 20" Moderately deep --- ___ to ___ " Deep --- ___ to ___ " _____ _____ --- ___ or ___ "

SOIL PROFILES

Diagrams of vertical profiles showing depths of soils





shallow	Refer to information panel, page A-35 to answer frames 21 - 24. 21. The depth of soil profile "A" would be classified as _____.
moderately deep	22. The depth of soil profile "B" would be classified as _____.
deep	23. The classification would be _____ for soil profile "C".
very deep	24. Soil profile "D" would be classified as _____.
moderately deep	25. Failure to find evidence of moisture or roots deeper than 22 inches would indicate _____ soil depth.

Soil surface texture is classified according to the proportion of sand, silt, and clay that make up the soil mass.

The size of individual particles of soil influences the ability of the soil to absorb and store water and air.

After looking at and feeling the soil, we can then classify the surface texture as:

Fine - "clayey" soils that feel sticky or slick to the touch.

Medium - "silty" soils that feel smooth or "floury" to the touch.

Coarse - "very sandy" soils that feel gritty or abrasive to the touch.

surface texture	If you have not read the information panel on soil surface texture, do so now. 26. Soil _____ _____ refers to the composition of the important top six inches of soil -- the root zone.
by looking at it and feeling it	27. Texture of clothing is sometimes referred to as "coarse." We speak of soils as fine, medium, or coarse textured. We are referring to a six-inch layer. How would you decide whether a soil were fine, medium, or coarse?
soil surface texture	28. Perhaps a series of different sized sieves would work to determine s_____ _____ t_____.
fine, medium, or coarse	29. Sieves are used in the laboratory, but are awkward for field use. Field men learn to determine soil surface texture by moistening it and rubbing it between the thumb and forefinger. In this way they can determine if the soil surface texture is _____, _____, _____.
sand, silt, clay	30. Soils are composed of _____, _____, and _____, the individual parts being called particles.

particle	31. _____ size determines ability of the soil to hold air and water.
air water	32. Particle size influences the ability of the soil to absorb and store _____ and _____.
coarse	33. Sandy soils feel abrasive and "gritty" to the touch. Sandy soils have a c_____ texture.
coarse	34. Coarse soils are predominately sand with some silt and clay. Desert soils are usually _____ in texture due to large proportions of sand.
fine	35. Soils having enough clay to feel "slick" and "sticky" have a f_____ texture.

sticky or slick	36. Fine textured soils feel _____ to the touch.
gritty	37. Coarse textured soil feels _____ to the touch.
medium	38. Soils with a large quantity of silt that feel smooth and floury are classified as having a m_____ texture.
silt	39. Medium textured soils are composed predominantly of _____. They feel smooth and "floury" to the touch.
smooth or floury	40. Medium textured soils feel _____ to the touch.

a-fine b-coarse c-medium	41. a. _____ textured soils feel sticky. b. _____ textured soils feel gritty. c. _____ textured soils feel smooth and floury.
fine - sticky. medium - smooth or floury. coarse - gritty.	42. List the classifications of soil surface texture and indicate how they feel.
soil surface texture	43. The purpose of this classification is to accurately field test a soil as to its _____ _____ _____.
particles	44. The individual parts of these soils are called soil _____, the size of which determines the ability of the soil to hold air and water.
sand, silt, clay	45. Soil is composed of varying proportions of _____, _____, and _____.

10	REVIEW A. Very shallow soils are 0 to _____ inches deep.
10-20	B. Shallow soils are _____ to _____ inches deep.
Moderately deep	C. _____ _____ soils are 20 to 36 inches deep.
deep 35 to 60	D. _____ soils are _____ to _____ inches deep.
60	E. Very deep soils are greater than _____ inches deep.

roots moisture	F. Soil depth is the effective depth that _____ and _____ can penetrate.
	Fine soils characterized by a sticky feeling when moist are chemically fertile but are often a problem physically. They are either too hard for adequate moisture penetration or too moist and sticky to disc and cultivate for seedbed preparation. Soil surface texture is an important consideration in land classification for hazard free land usage.
sand silt, clay	G. Soil is composed of varying proportions of _____, _____, and _____.
fine medium coarse	H. Depending upon the proportions of sand, silt, and clay, we speak of soils in the three textural categories _____, _____, and _____.
	The next section of this program will consider the effect of fine, medium, and coarse textured soils on the movement of air and water through the entire profile (depth) of the soil.

Soil permeability refers to the rate of movement of air and water through the subsoil. Soils may be placed into relative permeability classes through studies of structure, texture, cracking, density and other features. Structure refers to the arrangement of soil particles into granules, clods, columns, or crumbs. We classify permeability as:

Limiting - soils which have dense, heavy clay or clay pan subsoils. Soils under this classification feel sticky and plastic, have the appearance of putty, press out thin between the fingers without crumbling when wet.

Adequate - granular clay loam or silt loam subsoils. Soils with strata cracks usually running perpendicular to the surface. This type of soil is ideal for most agricultural purposes since the water, air, and plant roots can penetrate easily. Yet the soil column is firm and stable.

Excessive - sandy, coarse subsoils through which water and air move freely.

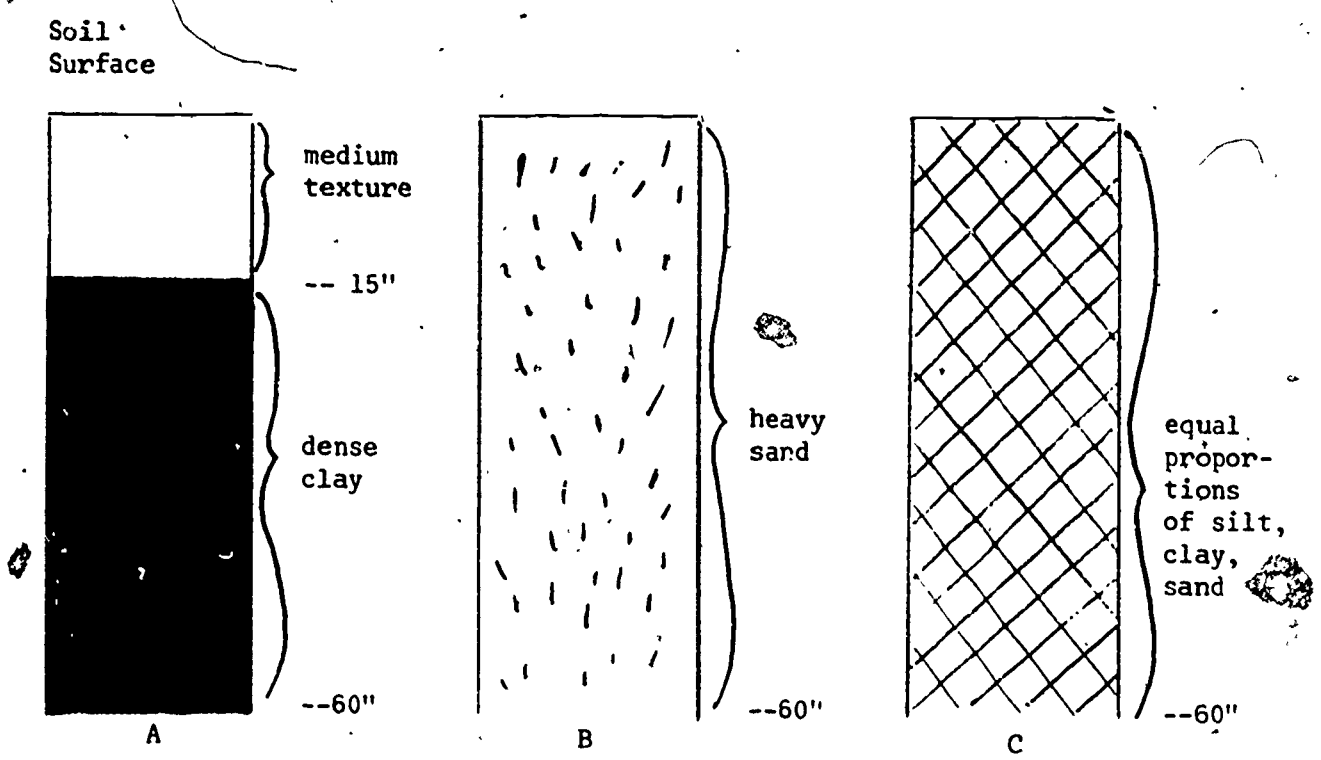
soil permeability	46. Soil depth, you will recall, was important as it affects the amount of moisture available to crops. Soil permeability refers to the rate of movement of air and water through the subsoil. How well excess moisture drains through the soil profile is a function of s_____ p_____.
permeability	47. Soils may be placed into relative _____ classes through studies of structure, texture, cracking, density, and other features.
moisture air	48. Structure of the soil profile is determined by the "clumping" of individual particles. This affects the movement of _____ and _____ through the entire soil profile. For our system of classification, we will divide soil permeability into limiting, adequate, or excessive.
limiting	49. Soils that have dense clays in their subsoil would limit movement of water through the profile. We would classify their permeability as _____.
clay	50. A common example of a soil profile having limiting permeability is one having a heavy layer of _____ in the subsoil.

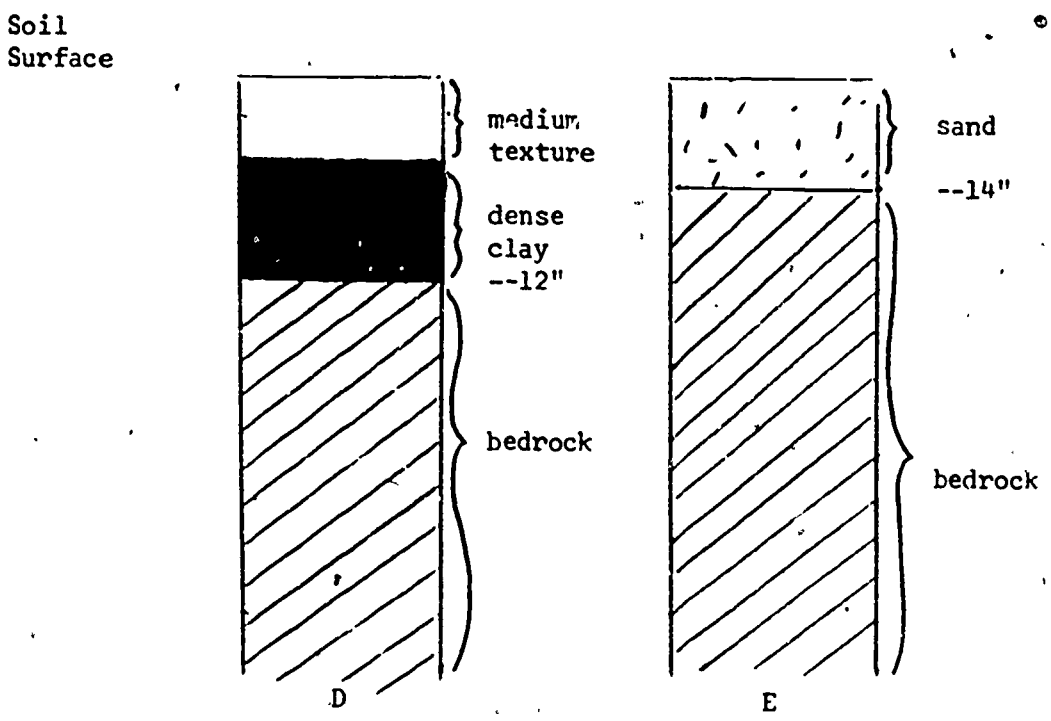
adequate	51. A medium texture soil throughout the profile would result in _____ permeability.
smooth or floury	52. A soil profile having adequate permeability would feel _____ to the touch throughout the profile.
excessive	53. A deep sandy soil would have excessive drainage of water through the profile. The permeability of this soil would be _____.
sand	54. A soil having excessive permeability would consist largely of _____.
surface texture	55. Permeability pertains to the effective depth of a soil and not to the surface six inches as does soil _____ _____.

permeability	56. A dense subsoil of a putty-like consistency would be classified as having limiting _____ that would limit water movement through the soil. Obviously a narrow horizontal band of soil of a particular texture can result in a limiting permeability.
excessive permeability	57. A soil that is excessively drained because of a sandy, coarse subsoil has _____ _____.
limiting permeability	58. Very slow movement of air and moisture through the soil indicates _____ _____
adequate permeability	59. A satisfactory movement of air and moisture through the soil is called _____ _____.
a-limiting b-adequate c-excessive	60. The three classifications of permeability are _____, _____, and _____.

SOIL PROFILES

Diagrams of vertical profiles showing permeability.





limiting	Refer to information panel, page A-48 to answer frames 61 - 65. 61. Profile "A" demonstrates _____ permeability.
excessive	62. Profile "B" is an example of _____ permeability.
adequate	63. Profile "C" is an example of _____ permeability.
limiting	64. "D" profile demonstrates _____ permeability.
excessive	65. "F" profile demonstrates _____ permeability.

light medium dark dark	66. Soil color is a rather subtle clue to the history of a particular soil. Soil color is divided into three divisions: light, medium dark, and dark. Write the three color divisions in the answer box.
high	67. Dark soil is nearly black and is usually (high or low) in inherent fertility.
dark	68. Soil with a high inherent fertility level is usually classified as having a _____ color.
medium	69. Medium dark soil has a moderate level of inherent fertility. Dark gray to light brown soils indicate a _____ dark color.
medium	70. Medium dark soil has a (high, medium, low) level of inherent fertility.

light	71. A low or very low inherent fertility is indicated by a _____ color.
low	72. Light gray to pale brown surface soils usually have a _____ inherent fertility level.
soil fertility	73. Soil color is not always a reliable clue to inherent fertility. Soil color may or may not indicate inherent _____ _____.
dark medium dark light	74. Soil color is divided into three divisions. They are _____, _____ _____, and _____.
a-medium b-low c-high	75. List the probable inherent fertility level indicated by each of the following soil colors: a. medium dark - _____ b. light - _____ c. dark - _____

Slope. Slope is very important because it influences the rate at which water runs over the soil. This runoff is one of the causes of erosion. Slope also influences the way in which the land can be farmed. Slope is expressed by the number of feet of fall in each 100 linear feet. Slope ranges vary widely in different areas. For instance, land with 8 to 12 feet fall per 100 linear feet might be considered steep or very steep in some climates and soil conditions. It might be considered only moderately sloping under other conditions of less intensive climatic conditions. It is necessary, therefore, that for purposes of judging contests, slope ranges applicable to the contest area be used. The following will give an idea of the manner in which slope ranges are expressed:

(2% means 2 feet fall per 100 linear feet of distance)

Nearly level

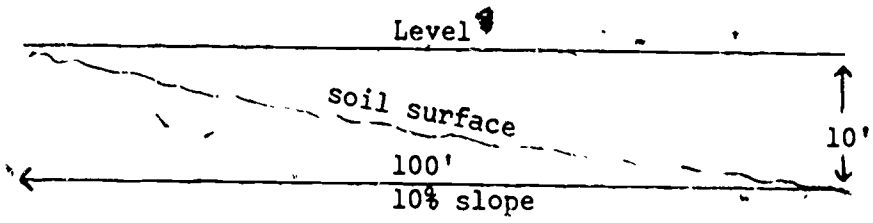
Gently sloping

Moderately sloping

Strongly sloping

Steep

Very steep



slope	If you have not read the information panel on soil slope, do so now. 76. Slope is important as it directly influences water run off and erosion. _____ is expressed as the number of feet of fall per 100 linear feet of "run."
nearly level gently sloping moderately sloping strongly sloping steep very steep	77. Slope ranges are expressed as nearly level, gently sloping, moderately sloping, strongly sloping, steep, and very steep. Write the slope ranges in the answer box.
2	78. Two per cent fall means _____ feet fall per 100 linear feet.
slope	79. Erosion is partially caused by water runoff, which is due to per cent of _____. The slope of the land is the major influence on erosion.
level, sloping, sloping, steep	80. Slope is divided into six categories. They are nearly _____, gently s_____, moderately s_____, strongly sloping, steep, and very _____.

nearly gently moderatelv strongly steep very	81. The six categories of slope are: _____ level, _____ sloping, _____ sloping, _____ sloping, _____ and _____ steep.
nearly level, gently sloping, moderately slop-ing, strongly sloping, steep very steep	82. List the six categories of slope.
nearly level gently sloping	83. If you answered from #82 without error, well done! Go to page A-56.Otherwise, continue with frame #83. Very little erosion might be expected due to a _____ _____ slope or a _____ _____ land.
moderately sloping strongly sloping steep very steep	84. Greater degrees of erosion might be expected on slopes ranging from m_____ _____, to _____ _____ to _____ to _____ _____.
nearly level, gently sloping, moderately slop-ing, strongly sloping, steep, very steep	85. The six categories of slope are:

Soil drainage. How rapidly or slowly the land drains after snow melt or heavy rains. Land subject to overflow by streams is less attractive to the farmer than higher-laying well drained land. Flat slopes that drain slowly are less desirable than those that drain moderately well. Similarly, gravelly or sandy soils that are excessively drained and droughty are less desirable than those with moderate drainage. These classifications may be used:

Limiting - water is removed so slowly that the soil remains wet for a large part of the time.

Adequate - this is normal drainage, no water problems.

Excessive - water is removed in an excessive amount and rate, causing droughty conditions.

soil drainage	86. Soil drainage is a function (result) of soil permeability and slope. How rapidly or slowly the land drains after snow melt or heavy rain is called _____ _____.
soil drainage	87. _____ _____, the result of vertical movement of moisture through, and lateral movement across, the land is classified as limiting, adequate, or excessive.
limiting adequate excessive	88. You will notice that permeability and soil drainage are described by the same terms: _____, _____, or _____.
limiting	89. With limiting soil drainage, water is removed so slowly that the soil remains wet for a large part of the time. Swampy lands would have _____ drainage.
adequate	90. Adequate drainage is normal drainage with no water problems. A soil with adequate permeability and no slope problem will probably have _____ soil drainage.

limiting	91. A heavy clay subsoil and a "flat" slope might indicate _____ soil drainage.
adequate	92. A medium textured soil profile (topsoil and subsoil) with an even, moderate slope will probably have _____ soil drainage.
excessive	93. A soil profile that is coarse textured will probably have _____ soil drainage.
adequate	94. A fine surface texture with a medium texture subsoil will probably have _____ soil drainage. Soil drainage is a function of water movement through the soil (permeability) and across the soil surface (slope).
limiting adequate excessive	95. Soil drainage is classified as _____, _____ and _____.

Erosion. The loss of soil by the effects of water and wind is called erosion. Excessive accumulation of soil particles and sand due to the force of wind is also evidence of erosion.

The percentage of erosion can be measured by comparing the depth of topsoil at the field test site with topsoil in a nearby protected area where no erosion has occurred.

None to slight erosion - nearly all the original topsoil remains, or less than 25% of topsoil lost by erosion; no gullies which cannot be crossed by farm machinery.

Moderate erosion - the top several inches may be lost, 25% to 75% of topsoil lost by erosion, without frequent uncrossable gullies.

Severe erosion - the topsoil being farmed is less than a plow depth and the result is a mixture of topsoil and subsoil, or more than 75% of topsoil lost by erosion with occasional uncrossable gullies.

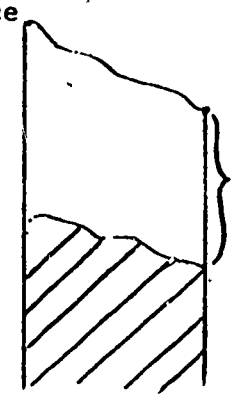
erosion	96. The loss of soil by the effects of water and wind is called _____.
wind and water	97. Erosion by _____ and _____ is evidenced by an accumulation of soil particles and sand, examples being the sand dunes of the desert and river deltas. These "accumulations" are materials which have been transported by wind or water from one place to another.
erosion	98. The extent of _____ is measured from the amount of original topsoil as opposed to the amount of topsoil present now.
none to slight, moderate, servere	99. Erosion terms, such as none to slight, moderate, and severe erosion are based on the percentage of erosion. Copy these three terms in the answer frame.
none to slight	100. Less than 25% loss of topsoil is called _____ to _____ erosion.

moderate	101. From 25% to 75% of topsoil loss is defined as _____ erosion.
severe erosion	102. When the topsoil being farmed is less than plow depth or when more than 75% is lost by erosion, we call this _____ _____.
none to slight moderate severe	103. For purposes of classification and correct technical language, then, we speak of erosion as (0-25%)_____ to _____, (25%-75%) _____, or (greater than 75%) _____.
none to slight 0-25%; moderate - 25-75%; severe-greater than 75%	104. The percentage of loss of topsoil determines which category of erosion a soil "fits." Now list the three divisions and their percentages.
original present (or terms which mean the same)	105. To calculate percentage of erosion, one must know the depth of _____ topsoil as opposed to the amount of _____ topsoil.

SOIL PROFILES

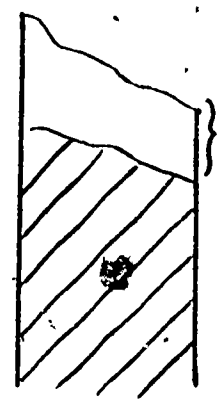
Diagrams of vertical profiles showing % of Erosion

Soil Surface



A_1

A



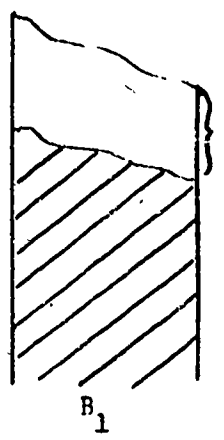
8" topsoil at present

8" present topsoil
16" original topsoil

$\frac{8}{16} = \frac{1}{2}$ or 50% topsoil remaining

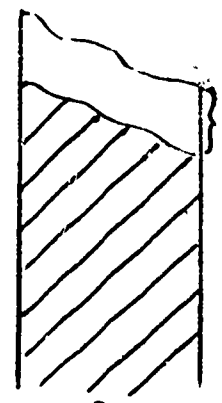
A_2

Soil Surface



B_1

B



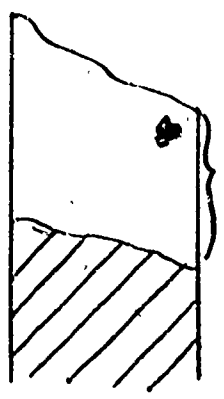
6" topsoil at present

$\frac{6}{8}$ present topsoil
original topsoil

$\frac{6}{8} = \frac{3}{4}$ or 75% topsoil remaining

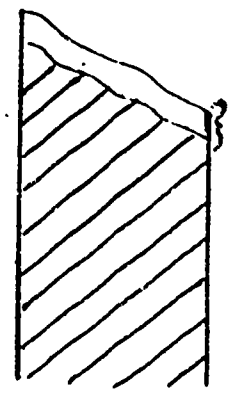
B_2

Soil Surface



C_1

C



2" topsoil at present

? _____
? _____
? _____ % of topsoil remaining

C_2

moderate	Refer to information panel, page A-61 to answer frames 106-108. 106: Soil profile "A" (A_1 and A_2) would be classified as _____ erosion.
none to slight	107. Soil profiles "B" (B_1 and B_2) would be classified as _____ erosion.
severe	108. Soil profiles "C" (C_1 and C_2) would be classified as _____ erosion.
50%	109. Given 20" original topsoil and 10" of topsoil now evident, what per cent loss of erosion would this be?
66% moderate	110. Given 9" of original topsoil and "now present, the per cent of loss and the category of erosion are _____ and _____.

I	111. Land used best for cultivated crops are land classes I, II, III. Land classes II and III are best used in rotation to maintain a relatively high organic matter content. Land class IV is grouped with cultivable land classes also. Land class _____ can be cultivated every year with relatively small risk.
I	112. Land class IV is best used for hay or pasture with an occasional cultivated crop possible. Land class VI is best used for range. Corn crop every year is economically sound on land class _____ soil. Land classes I, II, III, IV can be cultivated. Land classes VI, VII, VIII are not cultivated because of extreme hazards.
VI	113. Land class VII soil is best used for range and woodland and land class VIII for recreation and wildlife. Land suitable for grazing cattle is classified as land class _____.
VIII	114. Land most suited for parks is classified as land class _____.
I	115. The best land capability class a soil with moderate permeability can be assigned is land class _____.

I	116. The maximum land capability class that can be assigned to a soil with a light colored surface soil is _____.
increases	117. The texture of a soil affects its water holding capacity. As the soil particles size decreases the water holding capacity _____.
b-more fertilizer, because the soil drains rapidly.	118. A coarse textured soil will probably require (a) less fertilizer (b) more fertilizer, (c) tile drains.
b-aggregates; (organic matter encourages aggregation of soil)	119. Structure of a soil refers to how individual soil particles are grouped together to form (a) organic matter, (b) aggregates, (c) clay.
IV, III, IV	120. The maximum land capacity class of: a shallow soil is _____, a moderately deep soil _____, a deep soil _____.

IV	121. The maximum capability class of severely eroded soil is land class _____.
II	122. The maximum land class of a moderately eroded soil is land class _____.
V or VI (V - where this class is used)	123. The maximum land capability class of a soil with limited surface drainage is land class _____. Field practice is necessary as well as study of detailed land class description to master correct assignment of a soil to a land class.
c	124. Single grain structure is associated with soils high in (a) silt, (b) clay, or (c) sand.
permeability	125. The ease with which water moves through the soil is referred to as _____.

climate	126. Climate is important because it influences the kinds of crops that can be grown on a soil. The most important factor of climate to crop response is temperature. _____ influences the kinds of crops that can be grown on a soil.
climate	127. Extremely low temperatures, or too short a period of favorable temperature for crop maturity, or occurance of frost pockets, where frost occurs during the growing season, are definite limitations of _____.
	128. These low temperatures and frost pockets are found in the northern United States or at high elevations or in valleys and pockets with poor natural air drainage.
Climate	129. _____ is limiting where there is poor air drainage or a short growing season of less than 120 days.
climate	130. Adequate _____ is represented by a growing season greater than 120 days, and no climatic problems.

	131. Stoniness refers to the relative proportion of stones in or on the soil. They have an important bearing on soil use because of their interference with the use of agricultural machinery.
non-stony	132. We classify non-stony as no stones or too few to interfere with tillage. The word is _____.
	133. We classify land as stony if there are sufficient stones to make all use of machinery impracticable except for very light machinery or hand tools for pasture improvement.
	134. pH is an expression used to measure the acidity or alkalinity of a soil. This is determined by the use of chemical indicators applied to the soil with resulting colors compared to a color chart of known determinations. pH is important because all plants grow within a certain reaction range. Some plants will grow best in slightly acid soils, but will not grow in alkaline soil. Different plants grow best in a slightly alkaline soil. If we know the pH of a soil we know what type of plant will grow best in that pH range. We classify pH on a scale of 0-14 as follows: Acid - below 6.6; Neutral - 6.6-7.3; Alkaline - above 7.4.
pH	135. _____ is a measure of a soil's acidity or neutrality.

acid	136. Soils below a pH of 6.6 are _____.
7.4	137. Soils with a pH above _____ are alkaline.
neutral	138. Soils with a pH between 6.6 and 7.3 are _____.

Sample

LAND JUDGING SCORE CARD

Name or Number _____

Field Number _____

INVENTORY OF LAND FACTORS
Part I

Indicate your answer by an X in the proper square.

EFFECTIVE DEPTH
- Very Deep . . . . . (____)
- Deep . . . . . (____)
- Moderately Deep . . . . (____)
- Shallow . . . . . (____)
- Very Shallow . . . . . (____)

SURFACE TEXTURE
- Fine . . . . . (____)
- Medium . . . . . (____)
- Coarse . . . . . (____)

PERMEABILITY
- Limiting . . . . . (____)
- Adequate . . . . . (____)
- Excessive . . . . . (____)

SLOPE
- Nearly Level . . . . . (____)
- Gently Sloping . . . . (____)
- Moderately Sloping . . (____)
- Strongly Sloping . . . (____)
- Steep . . . . . (____)
- Very Steep . . . . . (____)

SURFACE DRAINAGE
- Limiting . . . . . (____)
- Adequate . . . . . (____)
- Excessive . . . . . (____)

EROSION
- None to Slight . . . . (____)
- Moderate Erosion . . . (____)
- Severe Erosion . . . . (____)

CLIMATE
- Limiting . . . . . (____)
- Adequate . . . . . (____)

STONINESS
- Non-stony . . . . . (____)
- Stony . . . . . (____)

RECOMMENDATIONS
Part II

Recommendations for best land use. (Select One)

- Cultivated . . . . . (____)
- Hay or Pasture . . . . . (____)
- Range . . . . . (____)
- Woodland . . . . . (____)
- Wildlife, Watershed, & Recreation . . . . . (____)

CLASSIFICATION

Indicate by an X the major limiting factors or problems to be considered in selecting the proper land classification.

- Depth . . . . . (____)
- Surface Texture . . . . . (____)
- Permeability . . . . . (____)
- Color . . . . . (____)
- Slope . . . . . (____)
- Surface Drainage . . . . . (____)
- Erosion . . . . . (____)
- Climate . . . . . (____)
- Stoniness . . . . . (____)

LAND CAPABILITY CLASS
(Circle One)

I II III IV V VI VII VIII

LAND Name _____

POST-TEST

Underline the correct answer(s).

1. Land classes suitable for cultivation are _____, _____, _____, and _____.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

2. Land classes not suitable for cultivation are _____, _____, and _____.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

3. Land slop is defined as the number of feet fall per _____.

   a. 10 feet
   b. 100 feet
   c. 25 feet
   d. 1,000 feet

4. Soil depth is the effective depth that roots and _____ can penetrate the soil.

   a. moisture
   b. a drill
   c. a shallow rooted plant
   d. a post hole digger

5. Soil permeability refers to the rate of movement of _____ and _____ through the soil.

   a. roots
   b. moisture
   c. air
   d. fertilizer

6. Soils that feel "sticky" when moist are _____ textured soils.

   a. loam
   b. silt
   c. medium
   d. fine
   e. coarse

Name _____

7. "Silty" or "Loamy" textured soils are _____.

   a. fine
   b. medium
   c. coarse
   d. heavy

8. _____ is the major influence for rate of water run-off.

   a. Slope
   b. Soil drainage
   c. Permeability
   d. Flexibility

9. Soil _____ refers to how rapidly the land drains after snow melt or heavy rains.

   a. length of life
   b. drainage
   c. permeability
   d. slope

10. Moderate erosion is a loss of topsoil between _____ per cent.

   a. 10-20
   b. 15-30
   c. 25-75
   d. 30-60

11. The acidity, or alkalinity (sweetness) of a soil are measured in terms of _____.

   a. pH
   b. bH
   c. sourness
   d. cation exchange

12. Land that can be used regularly for crops in a good rotation but needs intensive treatment and is subject to serve limitations in use for crop land is land class _____.

   a. I
   b. III
   c. IV
   d. VI

13. Land that is very deep is greater than _____ deep.

   a. 30"
   b. 40"
   c. 50"
   d. 60"

Name _____

14. The individual parts of soil are called soil _____.

    a. conglomerates
    b. clumps
    c. particles
    d. pieces

15. A common example of a soil profile having limiting permeability is one having a heavy layer of _____ in the subsoil.

    a. sand
    b. minerals
    c. clay
    d. nutrients

OE 6000 (9-66) DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION
WASHINGTON 25, D.C.

ERIC DOCUMENT RESUME

DATE OF RESUME: December 1966

1. ACCESSION NO. | 2. ERIC SATELLITE CODE | 3. CLEARING HOUSE CONTROL NO.

4. SOURCE: U.S. Dept. of Health, Education, and Welfare
Office of Education, Bureau of Research
Final Report 6/65 - 12/66

5. TITLE: Land Judging and Plant Nutrition: A Programmed Instruction Unit. Project No. ERD-257-65

6. AUTHOR(S): Long, Gilbert A.

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13. EDITOR(S): N.A.

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15. ABSTRACT (250 words max.)

Principles and facts requisite for effective land classification and plant nutrition practices were identified by examination of recent scientific reports. Utilizing that information, the author involved sixteen Vocational Agriculture teachers in development and experimental use of this unit of programmed learning materials. The teachers are presently (1966-67) engaged in experimental use of the materials. Evidence of instructional results is not yet available. There is substantial evidence that teacher involvement has activated analytical assessment of objectives and interest in innovative instruction.

16. RETRIEVAL TERMS (Continue on reverse)

Land-judging
Soil Classification
Plant Nutrition
Programmed Materials

17. IDENTIFIERS

Vo-Tech. Ed R and D Project
ERD-257-65

Figure 3. ERIC Document Resume

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Field 6. Author(s): Enter personal author(s) (corporate author is entered in field #1), last name first. (Example: Doe, John.) If two authors are given, enter both. In the case of three or more authors, list only the principal author followed by "and others," or, if no principal author has been designated, the first author given followed by "and others." (Example: Doe, John and others.)

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16. RETRIEVAL TERMS (Continued)

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