

Lesson A6–2

Conducting Agricultural Research

Unit A. Agricultural Literacy

Problem Area 6. Determining the Role of Research and Development in Agriculture/Horticulture

Lesson 2. Conducting Agricultural Research

New Mexico Content Standard:

Pathway Strand: Agribusiness Systems

Standard: VI: Use sales and marketing principles to accomplish an AFNR business objective.

Benchmark: VI-A: Conduct market research.

Performance Standard: 1. Evaluate methods of marketing products and services. 2. Apply economic principles to marketing (e.g., supply and demand). 3. Research products and service design(s).

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Define the research process and some practical applications in agriculture.
2. List and explain the five major steps in the scientific method.
3. Explain safety procedures that should be followed in the agriscience laboratory.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany this lesson:

Cooper, Elmer E. *Agriscience Fundamentals and Applications*. Albany, New York: Delmar Publishers, 1997. (Textbook, Unit 3)

Lee, Jasper S. and Diana L. Turner. *AgriScience*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapters 1 and 2)

Other Resources. The following resource may be of use to teachers and students:

Osborne, Edward W. *Biological Science Applications in Agriculture*. Danville, Illinois: Interstate Publishers, Inc., 1994. (Textbook, Chapters 1 and 2)

List of Equipment, Tools, Supplies, and Facilities

Overhead projector
Writing surface
Transparencies from attached masters
Copies of Student Lab Sheet

Terms. The following terms are presented in this lesson (shown in bold italics):

Control
Dependent variable
Experiment
Hypothesis
Independent variable
Replication
Research
Research process
Scientific method
Variable

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Provide the class with an example of a research problem in agriculture. Ask students to describe how they would go about solving the problem. Let this lead to a discussion of the research process and the scientific method. Take the time to discuss the practical applications of research in the agriculture industry. Help

students understand the important role researchers play in assuring adequate and affordable supplies of food, clothing, and shelter that lead to a good quality of life.

Summary of Content and Teaching Strategies

Objective 1. Define the research process and some practical applications in agriculture.

Anticipated Problem: What is research? How can the research process be practically used in agriculture?

- I. **Research** is the careful and diligent search for answers to problems. The **research process** is a systematic approach for discovering the unknown.
 - A. The experimental method is the most common type of research in agriscience. When using the experimental method, all factors except the one under investigation are held constant.
 1. The factors in an experiment are known as variables. A **variable** is a characteristic by which an object may be described. Experiments involve two types of variables.
 - a. An **independent variable** is the factor in an experiment that is manipulated.
 - b. A **dependent variable** is the characteristic that will be observed. It is expected to change as a result of the independent variable.
 2. A **hypothesis** is a tentatively accepted theory that explains the relationship between two variables.
 3. **Control** is the process of holding factors constant. It allows the effects of independent variables to be eliminated so that only the effects of the dependent variable are measured.
 4. **Replication** is the exact duplication of an experiment. It allows the results of the experiment to be verified across numerous trials.
 - B. Some examples of the practical applications of research in agriculture include:
 1. Development of disease- and pest-resistant plant varieties
 2. Use of variable rate technology (VRT) in the more efficient use of crop inputs
 3. Development of more efficient feeds for livestock and fish

Students should be provided with copies of the suggested references. Have them read the “Research Use” section in Chapter 2 of AgriScience and the “Research Process” section in Chapter 1 of Biological Science Applications in Agriculture. Use TM: A6–2A to lead a class discussion on the factors in an experiment. Provide students with a few example experiments. Have them identify the independent and dependent variables.

Objective 2: List and explain the five major steps in the scientific method.

Anticipated Problem: What are the five major steps in the scientific method?

- II. The *scientific method* is a process that involves asking questions and seeking answers in an organized way. There are five important steps in the scientific method. Sometimes the order of the steps may be changed or the number varied, but a logical process must be used.
- A. Identify the problem—the problem must be defined in order for it to be solved. If live-stock are not eating, their failure to eat is not the problem, but a symptom. The problem relates to why they are not eating.
 - B. Get information—involves gathering facts about the problem. This step is often referred to as data collection.
 - C. Suggest an answer—involves forming a hypothesis which possibly explains the problem’s cause.
 - D. **Experiment**—a trial that tests the hypothesis.
 - E. Form conclusion—involves making a judgement based on the results of the experiment. Often, the experiment is replicated before forming a conclusion.

Students should be provided with copies of the suggested references. Have them read the “Scientific Method” section in Chapter 2 of AgriScience and the “Process of Scientific Inquiry” section in Chapter 1 of Biological Science Applications in Agriculture. Use TM: A6–2A to lead a discussion of the five important steps in the scientific method. Provide students with examples of experiments. Have them formulate the five steps for the examples.

Objective 3: Explain safety procedures that should be followed in the agriscience laboratory.

Anticipated Problem: What are the safety practices that should be followed when conducting experiments in the agriscience laboratory?

- III. Agriscience research often involves work in a laboratory. The laboratory can be a dangerous place if proper precautions are not followed.
- A. General safety includes precautions which should be followed at all times. Examples include:
 - 1. Locate and learn to use all safety equipment.
 - 2. Never eat in a laboratory.
 - 3. Keep the work area clean and uncluttered.
 - B. Dressing properly will help to avoid accidents.
 - 1. Wear eye protection around chemicals and hot liquids.
 - 2. Do not wear loose-fitting sleeves or open-toed shoes.
 - 3. Tie back long hair.

- C. Use caution around heat and fire.
 - 1. Do not leave hot plates or burners unattended.
 - 2. Do not reach over open flames.
 - 3. Use proper glassware when heating.
- D. Chemicals in the laboratory must be handled carefully.
 - 1. Do not taste or touch chemicals.
 - 2. Do not inhale chemicals.
- E. Lab equipment should be used properly.
 - 1. Never use chipped or broken glassware.
 - 2. Do not use direct sunlight as a light source for microscope mirrors.
- F. Specimens in the laboratory must be treated with caution.
 - 1. Treat live animals gently. Their well-being is important.
 - 2. Do not cut into a specimen while holding it in your hand.
 - 3. Properly dispose of specimens.
- G. Use caution with electrical equipment.
 - 1. Examine equipment for broken or frayed wires.
 - 2. Run electrical cords away from foot traffic.
 - 3. Insure that the area around equipment is dry.
- H. Report all accidents.
 - 1. Report accidents immediately to the teacher.
 - 2. Clean up spills immediately.
 - 3. Use dustpans and brooms to remove broken glass.

Provide students with copies of the suggested references. Have them read and complete the activities in the “AgriScience Laboratory and Safety Skills” of the Activity Manual for AgriScience. Use TM: A6–2C to review the laboratory safety symbols. Assign LS: A6–2A as homework. Have students read and sign the safety contract. Also have their parent or guardian sign the contract. Instruct the students to return the signed contracts so that you can keep them on file.

Application. Application can involve the following student activity using the attached lab sheet:

Laboratory Safety Contract—LS: A6–2A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=c, 2=g, 3=f, 4=e, 5=d, 6=b, 7=a

Part Two: Short Answer

1. Identify the problem.
2. Get information.
3. Suggest an answer.
4. Experiment.
5. Form conclusions.

Test

Lesson A6–2: Conducting Agricultural Research

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|-----------------------|-------------------------|-------------|
| a. control | d. independent variable | g. variable |
| b. dependent variable | e. research | |
| c. hypothesis | f. scientific method | |

- _____ 1. A tentatively accepted theory that explains the relationship between two variables.
- _____ 2. A characteristic by which an object or phenomenon may be described.
- _____ 3. Careful, systematic investigation that involves asking questions and seeking answers.
- _____ 4. Careful and diligent search for solutions to problems.
- _____ 5. The variable in the experiment that is manipulated.
- _____ 6. The variable in the experiment that is measured to determine the effects of the independent variable.
- _____ 7. To hold constant.

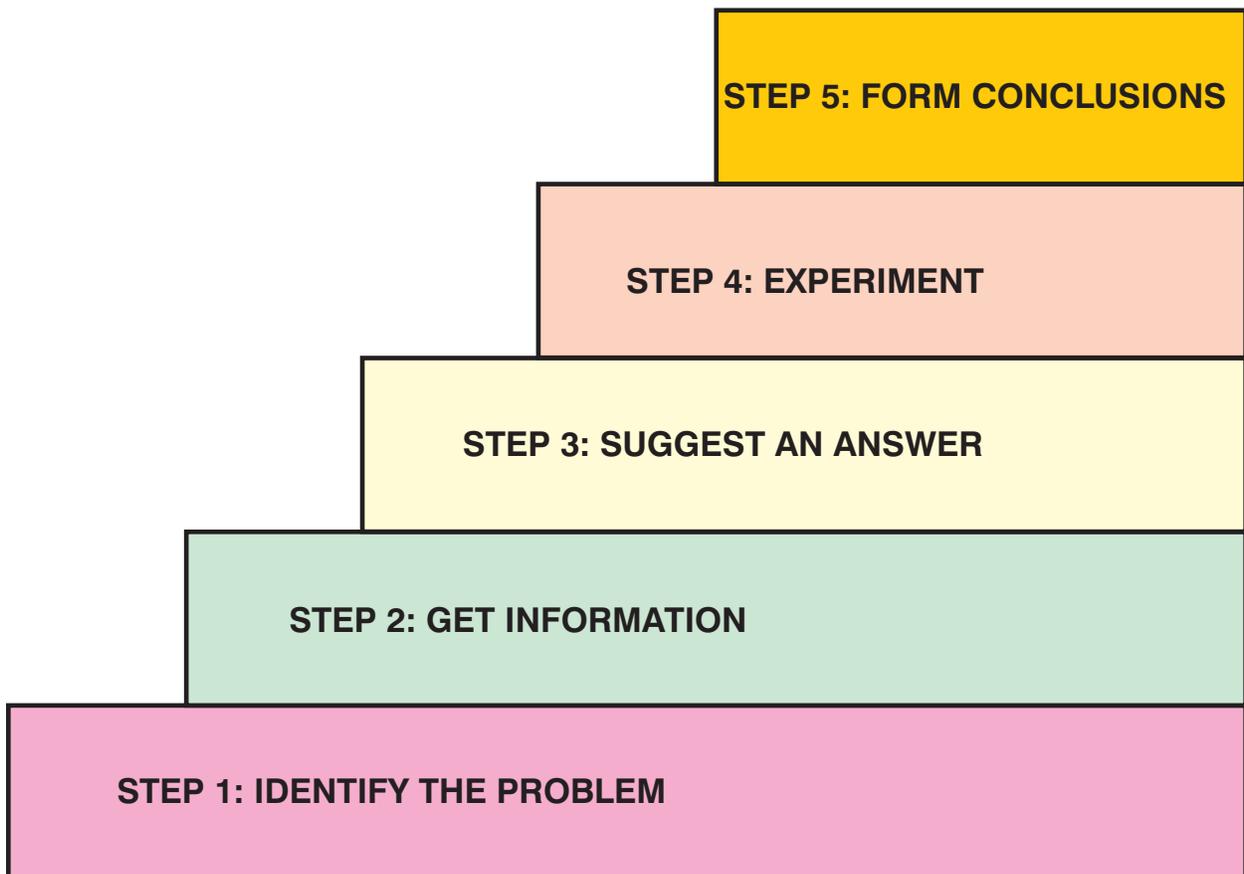
Part Two: Short Answer

List the five major steps in the scientific method.

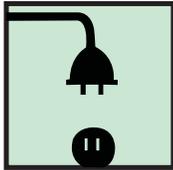
Factors in an Experiment

1. **Variable**—characteristic by which an object may be described.
 - **Independent variable**—the factor that is manipulated.
 - **Dependent variable**—the characteristic to be observed.
2. **Hypothesis**—a tentatively accepted theory that explains the relationship between variables.
3. **Control**—the process of holding factors constant.
4. **Replication**—the exact duplication of an experiment.

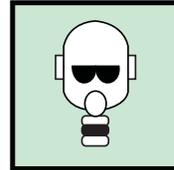
Five Steps of the Scientific Method



AgriScience Laboratory Safety Symbols



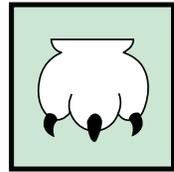
electrical safety



gas precaution



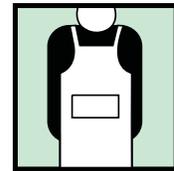
hand safety



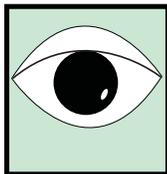
animal safety



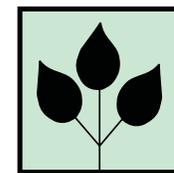
poison



clothing protection



eye safety



plant safety



fire safety



explosion danger

Lab Sheet

Student Safety Contract

STUDENT SAFETY CONTRACT

I, _____, a student in agriscience at _____, agree to follow all safety rules and regulations as given by my instructor. I realize that following these rules is necessary for the safe operation of my school laboratory and for the safety of other students, the teachers, and me. I agree to cooperate fully with my teacher and other students. I will act responsibly to look for possible safety hazards because I know that much of the responsibility for safety is up to me. I will notify the teacher of any safety problems or accidents that occur. I have read the safety rules and will comply with them to the best of my ability. I understand that violation of these rules may result in the loss of laboratory privileges and possible disciplinary actions.

Signed: _____ student

Date: _____

I understand that my child is responsible for his/her own conduct, with supervision and guidance by the teacher.

Signed: _____ Parent or guardian

Date: _____