

Lesson A1–3

Reporting Agricultural Research

Unit A. Research

Problem Area I. Scientific Investigation in Agriculture

Lesson 3. Reporting Agricultural Research

New Mexico Content Standard:

Pathway Strand: Communications

Standard: II: Use oral and written communication skills in creating, expressing and interpreting information and ideas including technical terminology and information within AFNR.

Benchmark: II-B. Compose written material to present technical information.

Performance Standard: 1. Compose multi-paragraph writing containing technical concepts, knowledge and vocabulary to complete an effective document. 2. Develop and incorporate tables, charts, graphs, and figures to support written and oral communications. 3. Use information technology to design, produce, and present written and multimedia materials.

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

1. Identify the major parts of a research report.
2. Explain the general guidelines for preparing a research report.
3. Explain how to properly include tables and figures in a research report.

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 the lesson:

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

Other Resources. The following resources will be useful to students and teachers:

American Psychological Association. *Publication Manual of the American Psychological Association*. Washington, D.C.: American Psychological Association, 1995. (Chapters 3 & 4)

Best, John W. and James V. Kahn. *Research in Education*. Needham Heights, MA.: Allyn and Bacon, 1993. (Chapter 3)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

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

Bar graphs
Charts
Circle or pie graphs
Conclusions
Dependent variables
Drawings
Figure
Findings or results
Graphs
Hypothesis
Independent variable
Introduction
Line graphs
Procedures or methods
References
Related studies
Research problem
Tables
Title page

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.

Give students copies of two or more quality research papers. Ask them to skim the papers. Ask students to name adjectives that describe the papers. Some examples may be: organized, typed, long, etc. Then ask the student to identify ways that the different papers are similar. Lead discussion towards the basic format that all the research papers follow.

Summary of Content and Teaching Strategies

Objective 1: Identify the major parts of a research report.

Anticipated Problem: What are the major parts of a research report?

- I. Once research has been conducted, the information gathered needs to be disseminated to other individuals who might be interested in the findings. In producing these reports to share their new knowledge, researchers must follow an agreed upon format for research papers. The paper is broken down into various sections. Each section has a specific purpose. A proper research paper should include the following sections:
 - A. **Title page**—There are several pieces of information that should be included on the title page of an agricultural research paper. The page should include the researcher’s name, title of the experiment, and date that the report is written. Other information may be included on this page as instructed by a teacher or other supervisor.
 - B. **Introduction**—This beginning section of your research paper should be a paragraph that explains why the experiment was conducted. Use several sentences to describe the need for the research and the logic for the experiment. The introduction section’s goal should be to make it clear to the reader why the research was conducted.
 - C. **Research problem**—This section includes a precise statement of what the research addresses. This can often be most easily and clearly stated in the form of a question. Usually a single problem drives a particular experiment, but sometimes one or more secondary problems are also under investigation. All research problems to be addressed in the experiment should be stated in this section of the research report.
 - D. **Hypothesis**—This is a prediction about the relationships of variables in the experiment. Agricultural research often looks for differences between groups of subjects in the experiment. Hypotheses can be stated to indicate that no difference between two or more groups is expected in your experiment. However, more often a researcher will anticipate that one group will differ from the other. In this case, the hypothesis will be stated to reflect the difference that is expected.
 - E. **Related studies**—This is a very important phase of the research process and an important part of the research report as well. For this section, the researcher will conduct a

study of past experiments that have been done that can relate to the research problem addressed in this experiment. The research should then summarize the findings of the past studies in the field. It is imperative that the writer use correct citation of and give specific credit to the researchers and experiments that are discussed in this section. It is important that this section be included in the research process so that time, effort, and money will not be wasted conducting experiments for research problems that have already been answered by another researcher.

- F. **Procedures or methods**—This section of the written research report should include a detailed and complete description of how the experiment was conducted. A good procedure or method section in a report make it possible for others to replicate your experiment by following the same procedures. Clearly written procedures that produce the same results time after time will lend credibility to the research project. In this section, the *independent variable* (the characteristic that the researcher believes will affect another variable) and *dependent variables* (the characteristics that will be observed) should be identified. Levels of the independent variables and how they were established and maintained during the experiment should also be described in detail. A critical part of the procedures section is careful description of the procedures used for measuring the dependent variable. This includes when and how measurements or observations were taken. Methods used for summarizing and/or analyzing the data should also be described in this section of the written research paper.
- G. **Findings or results**—The findings section of the report should contain actual data generated from the experiment. These data are usually presented in tables, graphs, or similar summary formats. It is important that the units of measure for the data be included. Each data table or graph should be accompanied by several statements that highlight patterns that the data seem to follow. However, in this section of the written report limit comments to describing what the data look like versus what they mean. Data should be presented by hypothesis. That is, restate hypothesis one, and then present the data from the experiment that pertain to this hypothesis.
- H. **Conclusions**—Separating findings from conclusions is sometimes difficult. A rule to follow is that findings indicate what was found and conclusions suggest what the findings mean. Conclusions should closely parallel the hypothesis initially stated for the study. In fact, conclusions should specifically indicate whether or not each hypothesis in your experiment was confirmed.
- I. **Recommendations**—Many research reports will contain two types of recommendations:
1. **Recommendations for practice**—In developing recommendations for practice, the researcher should go back to the introduction section of the report and reflect on why the experiment was conducted. This practice usually suggests ways the research findings should be implemented. Of course, if the findings are inconclusive or contradictory, then the researcher may choose not to identify recommendations for practice.
 2. **Recommendations for further research**—There are several ways that a completed experiment can suggest areas where further research is needed. One common cir-

cumstance is where one scientist's findings contradict findings from a previous research project on the problem. In this case more evidence is needed before researchers can be confident in their results and conclusions.

- J. **References**—This section of the research report will include complete bibliographic information for any piece that was cited in any other section of the report. The list of references serves to make others aware of the research that you used to guide your study. The following information should be included for each study cited:
1. Author
 2. Date published
 3. Title
 4. Source (including issue and page number)
 5. Publishers

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the major parts of a research report. Chapter 2 in Biological Science Applications in Agriculture is recommended. Use TM: A1–3A and TM: A1–3B to aid in discussion on this topic.

Objective 2: Explain the general guidelines for preparing a research report.

Anticipated Problem: What are the general guidelines for preparing a research report?

- II. The physical appearance of a manuscript can enhance the research report's effect or detract from it. A well-prepared report looks professional to all who read the paper. Mechanical flaws, however, can cause readers to misinterpret the content of the report. There are several general guidelines that a writer should follow to produce a professional-quality research report.
- A. Paper—Type the manuscript on one side of standard-sized ($8\frac{1}{2} \times 11$ in.), heavy, white bond paper. All pages of one manuscript must be the same size. Do not use half sheets or strips of paper glued, taped, or stapled to the pages.
 - B. Typeface or Font—Use a serif rather than a sans serif font (lettering on figures, however, should be in a sans serif font). The size of the type should be 12 points. Do not use a compressed typeface or any settings on your word processor that would decrease the spacing between letters or words. The default settings are normally acceptable. The type on paper must be dark, clear, and readable. It must also photocopy well.
 - C. Line spacing—Double-space between all lines of the manuscript. Double-space after every line in the title, headings, footnotes, quotations, references, figure captions, and all parts of tables.
 - D. Margins—Leave uniform margins of a least 1 inch at the top, bottom, right, and left of every page.
 - E. Line length and alignment—The length of each typed line is a maximum of $6\frac{1}{2}$ inches. Do not justify lines; that is, do not use the word-processing feature that adjusts spacing

between words to make all lines the same length. Instead, use the flush-left style, and leave the right margin uneven.

- F. Page numbers—After the report pages are arranged in the correct order, number them consecutively, beginning with the title page. Number all pages except those for artwork in Arabic numerals (ex: 1, 2, 3) in the upper right-hand corner. The number should appear at least 1 inch from the right-hand edge of the page, in the space between the top edge of the paper and the first line of text.
- G. Paragraphs and Indentation—Indent the first line of every paragraph and the first line of every footnote five to seven spaces. For consistency, use the tab key. Type the remaining lines of text to a uniform left-hand margin. The only exceptions to these requirements are:
 - 1. Abstracts
 - 2. Block quotations
 - 3. Titles and headings
 - 4. Table titles and notes and figure captions

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the general guidelines for preparing a research report. Chapter 4 in Publication Manual of the American Psychological Association is recommended.

Objective 3: Explain how to properly include tables and figures in a research report.

Anticipated Problem: How do I properly include tables and figures in a research report?

- III. Tables and figures are efficient, enabling researchers to present a large amount of data in a small amount of space. **Tables** usually show exact numerical values, and the data are arranged in an orderly display of columns and rows, which aids in comparison. A **figure** is any type of illustration other than a table. A figure may be a chart, graph, photograph, drawing, or other depiction.
 - A. For several reasons it is worthwhile to be selective in choosing the number of tables to be included in the research paper. One reason is the reader may have difficulty sorting through a large number of tables and may lose track of your message. Tables that communicate the quantitative aspects of data are effective only when data are arranged so their meaning is obvious at a glance. After deciding what data to present but before constructing a table, the author should consider the following:
 - 1. Rounded-off values may display patterns and exceptions more clearly than precise values.
 - 2. A reader can compare numbers down a column more easily than across a row.
 - 3. Column and row averages can provide a visual focus that allows the reader to inspect the data easily.
 - B. Carefully consider whether to use a figure. Tables are often preferred for the presentation of quantitative data. The standards for a good figure are simplicity, clarity, and con-

tinuity. There are several different types of figures. Each has its own specific purpose. Some of the most common types of figures are:

1. **Graphs** are illustrations that show the relationships in a set of data. There are various types of graphs. Some of them are:
2. **Line graphs** are illustrations used to show the relation between two quantitative variables. The independent variable is plotted on the horizontal or “X” axis, and the dependent variable is plotted on the vertical or “Y” axis.
3. **Bar graphs** are illustrations used when the independent variable is categorical. Solid horizontal or vertical bars each represent one kind of datum.
4. **Circle or pie graphs** or 100% graphs are illustrations used to show percentages and proportions. The number of items compared should be kept to five or fewer. Order the segments from large to small, beginning the largest segment at 12 o’clock.
5. **Charts** are illustrations that can describe the relations between parts of a group or object or the sequence of operation in a process. Charts are usually boxes connected with lines.
6. **Drawings** are selective illustrations that give the author the flexibility to emphasize any aspect of an image or idea. They can be done from any of several views.
7. Photographs have excellent eye appeal. They should be of professional quality and should be prepared with a background that produces the greatest amount of contrast.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how to properly include tables and figures in a research report. Chapter 3 in Publication Manual of the American Psychological Association is recommended.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the end of the textbook chapters may also be used in the review/summary.

Evaluation. Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching

1 = b, 2 = c, 3 = f, 4 = i, 5 = g, 6 = j, 7 = d, 8 = h, 9 = a, 10 = e

Part Two: Completion

1. Rounded-off

2. margins
3. 12
4. replicate

Part Three: Short Answer

Title page, introduction, research problem, hypothesis, related studies, procedures or methods, findings or results, conclusions, recommendations, and references.

Test

Lesson A1–3: Reporting Agricultural Research

Part One: Matching

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

- | | | |
|-----------------|----------------|---------------------|
| a. References | b. Charts | c. Figure |
| d. Hypothesis | e. Line graph | f. Research problem |
| g. Introduction | h. Conclusions | i. Related studies |
| j. Title page | | |

- _____ 1. Can describe the relations between parts of a group or object or the sequence of operation in a process.
- _____ 2. Any type of illustration other than a table.
- _____ 3. A precise statement of what the research addresses.
- _____ 4. This section is a summary of the findings of the past studies in the field.
- _____ 5. This beginning section of your research paper should be a paragraph that explains why the experiment was conducted.
- _____ 6. This page should include the researcher's name, title of the experiment, and date that the report is written.
- _____ 7. Predictions about the relationships of variables in the experiment.
- _____ 8. Should specifically indicate whether or not each hypothesis in your experiment was confirmed.
- _____ 9. Will include complete bibliographic information for any piece that was cited in any other section of the report.
- _____ 10. Used to show the relation between two quantitative variables.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. _____ values may display patterns and exceptions more clearly than precise values.
2. Leave uniform _____ of a least 1 inch at the top, bottom, right, and left of every page of a research paper.

3. The size of the type used in a research papers should be _____ points.
4. A good procedures or methods section in a report make it possible for others to _____ your experiment by following the same procedures.

Part Three: Short Answer

Instructions. Provide information to answer the following question.

List the major sections of a research paper in order.

ELEMENTS OF A RESEARCH REPORT

1. **Title Page**—Name, title of research, date, class
2. **Introduction**—Need and justification for the study, background information
3. **Research Problem**—Specific question under investigation, specify variables
4. **Research Hypotheses**—One or more predictions about the relationships between two or more variables
5. **Findings from Related Studies**—Summary of similar, previous research findings from printed or informal sources
6. **Procedures**—Design, treatments, measurement techniques
7. **Findings**—Data tables and/or graphs with brief descriptive statements
8. **Conclusions**—Specific statements about the relationships between variables as shown in your experiment
9. **Recommendations**—Suggestions on how your results should be used; suggestions for further experimentation on this problem
10. **References**—Complete listing of all sources used in designing the experiment and preparing the research report

SAMPLE RESEARCH REPORT (EXCLUDING TITLE PAGE)

Introduction

Egg hatcheries have adopted a variety of techniques for handling eggs during the incubation period. In addition to controlling incubation temperature and relative humidity, eggs are incubated in an upright position and tilted back and forth several times daily. Trials have indicated that hatchability is greatest under these conditions.

The Research Problem

The research problem investigated in this experiment was, “*What effect does egg rotation during hatching have on hatching rate?*” The effects of egg position on hatchability were also investigated.

Hypotheses

1. Eggs that are tilted several times each day during the incubation period will have greater hatchability.
2. Egg position in the incubator (flat or on end) will have no effect on hatchability.

Related Studies

In a Cooperative Extension Service research bulletin (CES, 1993) Craddock and Thomas reported that tilting of eggs during the incubation period had a positive effect on hatchability. They cited several other studies which found similar results. However, the practice of tilting eggs during incubation had no effect on hatchability for smaller eggs, such as those from quail. Scientists at the Wilkes Research Center reported that egg position during incubation has no effect on hatchability (Cone, 1992). Experiments conducted by other students in this agriscience class have shown mixed findings for the effects of egg position and rotation on hatchability.

Procedures

Two incubators of the same brand and model were obtained for use in this experiment. Thermostats were calibrated so the same temperature was maintained in each incubator. Thermometers were used to verify incubation temperature. Each incubator was filled with 24 fertilized chicken

eggs. In one incubator all 24 eggs were placed on their sides. Twelve of the eggs were gently rolled back and forth four times (9 am, 11 am, 1 pm, 3 pm) during each day of the incubation period. The other 12 eggs were not disturbed during the 21 day period. A similar procedure was followed in the second incubator, except that all 24 eggs were positioned with the large end up. In this treatment 12 of the eggs were tilted back and forth at a 90° angle four times daily. Hatchability was defined as the percentage of eggs that hatched for each group of 24 eggs.

Findings

In the incubator with the eggs positioned on their sides, a total of 20 of the 24 eggs hatched (83.3%). This included 11 in the rotated group (91.7%) and 9 in the undisturbed group (75%). For the eggs positioned with the large end up, 22 (91.7%) of the eggs hatched, including all 12 (100%) of those that were tilted several times each day. The hatching percentage for the undisturbed, upright eggs was 83.3%

Conclusions

1. Tilting eggs several times per day during the incubation period significantly improves hatching percentage.
2. Hatchability is also increased by positioning eggs with the large end up throughout the incubation period.

Recommendations for Further Research

1. Vary the number of times eggs are tilted per day from none to four.
2. Compare the effects on hatchability of different techniques for adjusting egg position during incubation.

References

- Craddock, T. & Thomas, P. (1993). *The Effects of Egg Position on Hatchability*. Cooperative Extension Service Technical Report 2148, Prairie State University, Goodman, IL.
- Cone, B. (1992). Increasing Egg Hatchability. *AgriResearch*, Vol 53, (6), p. 22.