

Appendix A

Primary Trait Analysis for Anderson's Biology Class

This appendix contains two items: the primary trait scoring sheet developed by Anderson and used by outside raters, and scores for the 1983 and 1986 classes (Table A.1). See pp. 35–36 for explanation of the primary trait analysis procedure.

Primary Trait Scoring Sheet for Anderson's Class

Please evaluate the original research paper and assign an appropriate number of points for each section. In each category, higher numbers represent greater mastery. Please do not award partial scores.

Title

- 5 – Is appropriate in tone and structure to science journal; contains necessary descriptors, brand names, and allows reader to anticipate design.
- 4 – Is appropriate in tone and structure to science journal; most descriptors present; identifies function of experimentation, suggests design, but lacks brand names.
- 3 – Identifies function, brand name, but does not allow reader to anticipate design.
- 2 – Identifies function or brand name, but not both; lacks design information or is misleading.
- 1 – Is patterned after another discipline or missing.

Introduction

- 5 – Clearly identifies the purpose of the research; identifies interested audience(s); adopts an appropriate tone.
- 4 – Clearly identifies the purpose of the research; identifies interested audience(s).
- 3 – Clearly identifies the purpose of the research.
- 2 – Purpose present in Introduction, but must be identified by reader.
- 1 – Fails to identify the purpose of the research.

Scientific Format Demands

- 5 – All material placed in the correct sections; organized logically within each section; runs parallel among different sections.
- 4 – All material placed in correct sections; organized logically within sections, but may lack parallelism among sections.
- 3 – Material placed in the right sections, but not well organized within the sections; disregards parallelism.
- 2 – Some materials are placed in the wrong sections or are not adequately organized wherever they are placed.
- 1 – Material placed in wrong sections or not sectioned; poorly organized wherever placed.

Methods and Materials Section

- 5 – Contains effectively, quantifiably, concisely organized information that allows the experiment to be replicated; is written so that all information inherent to the document can be related back to this section; identifies sources of all data to be collected; identifies sequential information in an appropriate chronology; does not contain unnecessary, wordy descriptions of procedures.
- 4 – As above, but contains unnecessary information, and/or wordy descriptions within the section.
- 3 – Presents an experiment that is definitely replicable; all information in document may be related to this section; however, fails to identify some sources of data and/or presents sequential information in a disorganized, difficult pattern.
- 2 – Presents an experiment that is marginally replicable; parts of the basic design must be inferred by the reader; procedures not quantitatively described; some information in Results or Conclusions cannot be anticipated by reading the Methods and Materials section.
- 1 – Describes the experiment so poorly or in such a nonscientific way that it cannot be replicated.

Nonexperimental Information

- 5 – Student researches and includes price and other nonexperimental information that would be expected to be significant to the audience in determining the better product, or specifically states nonexperimental factors excluded by design; interjects these at appropriate positions in text and/or develops a weighted rating scale; integrates nonexperimental information in the Conclusions.

- 4 – Student acts as above, but is somewhat less effective in developing the significance of the nonexperimental information.
- 3 – Student introduces price and other nonexperimental information, but does not integrate them into Conclusions.
- 2 – Student researches and includes price effectively; does not include or specifically exclude other nonexperimental information.
- 1 – Student considers price and/or other nonexperimental variables as research variables; fails to identify the significance of these factors to the research.

Designing an Experiment

- 5 – Student selects experimental factors that are appropriate to the research purpose and audience; measures adequate aspects of these selected factors; establishes discrete subgroups for which data significance may vary; student demonstrates an ability to eliminate bias from the design and bias-ridden statements from the research; student selects appropriate sample size, equivalent groups, and statistics; student designs a superior experiment.
- 4 – As above, but student designs an adequate experiment.
- 3 – Student selects experimental factors that are appropriate to the research purpose and audience; measures adequate aspects of these selected factors; establishes discrete subgroups for which data significance may vary; research is weakened by bias *or* by sample size of less than 10.
- 2 – As above, but research is weakened by bias *and* inappropriate sample size.
- 1 – Student designs a poor experiment.

Defining Operationally

- 5 – Student constructs a stated comprehensive operational definition and well-developed specific operational definitions.
- 4 – Student constructs an implied comprehensive operational definition and well-developed specific operational definitions.
- 3 – Student constructs an implied comprehensive operational definition (possibly less clear) and some specific operational definitions.
- 2 – Student constructs specific operational definitions, but fails to construct a comprehensive definition.
- 1 – Student lacks understanding of operational definition.

Controlling Variables

- 5 – Student demonstrates, by written statement, the ability to control variables by experimental control and by randomization; student

makes reference to, or implies, factors to be disregarded by reference to pilot or experience; superior overall control of variables.

- 4 – As above, but student demonstrates an adequate control of variables.
- 3 – Student demonstrates the ability to control important variables experimentally; Methods and Materials section does not indicate knowledge of randomization and/or selected disregard of variables.
- 2 – Student demonstrates the ability to control some, but not all, of the important variables experimentally.
- 1 – Student demonstrates a lack of understanding about controlling variables.

Collecting Data and Communicating Results

- 5 – Student selects quantifiable experimental factors and/or defines and establishes quantitative units of comparison; measures the quantifiable factors and/or units in appropriate quantities or intervals; student selects appropriate statistical information to be utilized in the results; when effective, student displays results in graphs with correctly labeled axes; data are presented to the reader in text as well as graphic forms; tables or graphs have self-contained headings.
- 4 – As 5 above, but the student did not prepare self-contained headings for tables or graphs.
- 3 – As 4 above, but data reported in graphs or tables contain materials that are irrelevant and/or not statistically appropriate.
- 2 – Student selects quantifiable experimental factors and/or defines and establishes quantitative units of comparison; fails to select appropriate quantities or intervals and/or fails to display information graphically when appropriate.
- 1 – Student does not select, collect, and/or communicate quantifiable results.

Interpreting Data: Drawing Conclusions/Implications

- 5 – Student summarizes the purpose and the findings of the research; student draws inferences that are consistent with the data and scientific reasoning and relates these to interested audiences; student explains expected results and offers explanations and/or suggestions for further research for unexpected results; student presents data honestly, distinguishes between fact and implication,

- and avoids overgeneralizing; student organizes nonexperimental information to support conclusion; student accepts or rejects the hypothesis.
- 4 – As 5 above, but student does not accept or reject the hypothesis.
 - 3 – As 4 above, but the student overgeneralizes and/or fails to organize nonexperimental information to support conclusions.
 - 2 – Student summarizes the purpose and findings of the research; student explains expected results, but ignores unexpected results.
 - 1 – Student may or may not summarize the results, but fails to interpret their significance to interested audiences.

Table A.1 Primary Trait Scores for Anderson's 1983 and 1986 Classes

	1983	1986	P Values*
Title	2.95	3.22	.24
Introduction	3.18	3.64	.14
Scientific Format	3.09	3.32	.31
Methods and Materials	3.00	3.55	.14
Non-Experimental Info	3.18	3.50	.24
Designing the Experiment	2.68	3.32	.07
Defining Operationally	2.68	3.50	.01
Controlling Variables	2.73	3.18	.10
Collecting Data	2.86	3.36	.14
Interpreting Data	2.90	3.59	.03
Overall	2.93	3.42	.09

*P values: The probability values calculated were the P values of a T distribution with 20 degrees of freedom. The values were determined by interpolation between standard tabulated values for the T distributions (see Fisher and Yates 1973; Table F.3 in Dayton and Stunkard 1971).