PREFACE

POWER WRITING AND THE ART OF SCIENTIFIC CONCLUSIONS

With the onset of the Florida Comprehensive Assessment Test (FCAT) in mathematics, reading, and writing as well as the science FCAT testing scheduled to count as part of the school grade in 2006-2007 school year, it is imperative that schools take steps to prepare students for this battery of tests that will extend from grade three to grade eleven. Schools will a grade and a level of achievement from the State of Florida based on how well they perform on this assessment process.

It is logical and inevitable that preparation for this testing will involve the entire instructional staff of schools in every subject area to insure maximum levels of student achievement at each grade level. Interconnections among instructional strategies in individual subject areas with respect to performance tasks and problem solving can serve to strengthen student performance on the FCAT. The students will receive more preparation for this testing if it is reinforced, in every class they take through activities that familiarize them with the style of questioning they are likely to see on the tests. The effect is potentially synergistic.

Writing scientific conclusions for laboratory investigations has always been one of the more challenging tasks for science students to do and for science teachers to grade. The Power Writing Model used in language arts instruction contains many similarities to good scientific conclusion writing. This professional inservice workshop is intended to strengthen student performance on the Florida Writes portion of the FCAT as well as in science. Although the conclusions will still answer the seven basic questions that all scientific conclusions must address, they will also serve as a model for students to perform with a score of 3 or better on the "Florida Writes" test. Practicing with this model should improve student's ability to raise their achievement level.

This workshop will present the Scientific Conclusion Power Writing Model to participants. The participants will then conduct a complete scientific investigation and write a conclusion for that investigation using the Scientific Conclusion Power Writing Model to answer the seven essential questions that must be addressed in a well-written conclusion. Having accomplished this the participants should be able to incorporate this model into science classroom instruction as an FCAT support strategy.

TABLE OF CONTENTS

FCAT Power Writing Vocabulary as correlated to a Scientific Conclusion

Introduction: what you will prove and how you will prove it. A problem statement combined with a working hypothesis/trial solution.

Thesis statement: the single point of the entire essay (Problem to be solved).

Topic Sentence: the single point of a paragraph (In science the topic sentence varies with respect to the introductory, middle, and concluding paragraphs).

General Statement: one way to prove the topic sentence is true (supported or not supported). This is a general statement that is supported or not supported by the data collected and that will answer one of the seven questions that must be addressed when writing scientific conclusions.

Proof: Portion of investigation that addressed each question to be answered in a conclusion. It will be in the form of data collected which has been analyzed and interpreted to determine the findings which will or will not support the hypothesis that has been tested.

Commentary: opinion (inference or inferences made based on the data collected).

Concluding Sentence: one statement that is true (supported or not supported) for all the proof in the paragraph. Opinion (inference).

Concluding Paragraph: Statements that are true (supported or not supported) for all the proof in the entire essay. Opinion (inferences).

Organization: all essays and all paragraphs have a beginning, a middle, and an end. All scientific conclusions answer the seven basic questions that must be addressed when conducting complete scientific investigations.

Power Writing in Science Model

Introductory Paragraph:
State what you will prove. In science conclusions you would write the problem statement in the form of a question. You would then write your hypothesis which is the trial solution you have selected (this takes care of **question 1** in writing scientific conclusions which is "What was investigated?"). You are stating the ways you have proved your trial solution to be either supported or not supported by answering **question 2** in science conclusions which is "Was the hypothesis supported or not supported by the data?" This is how the rest of the sentences in the introductory paragraph are linked. They will describe the data that was collected and the major findings of the investigation (**question 3)** that supported or did not support the hypothesis as the solution to the restated problem.

Body Paragraphs:
The body paragraphs support the introductory paragraph by elaborating on the different pieces of information that were collected as data that either supported or did not support the original hypothesis. Using terms such as "as a matter of fact" or "for example" and "not only but also" for successive sentences is useful. Each finding needs its own sentence and relates back to supporting or not supporting the hypothesis. The body paragraphs may include **Question 4,** which describes how the findings compared with other researchers or groups investigating the same problem. The number of body paragraphs you have will depend on how many different types of data were collected. They will always refer back to the findings in the first paragraph. The concluding sentence can begin with a term such as "clearly" which would be followed by the statement that is true (support or non support) for the entire paragraph as it relates to the hypothesis. The commentary can include some inferences (opinions) although the major inferences should be reserved for the concluding paragraph.

Concluding Paragraph:
The concluding paragraph contains the major commentary about the problem statement and the hypothesis in the first paragraph of the conclusion. This is where **question 5**, what possible explanations can you offer for your findings? can be answered. The paragraph should also include answers to **questions 6 and 7** that include what recommendations do you have for further study and for improving the experiment and some possible applications of the experiment? At the end of the paragraph the problem statement and hypothesis (introduction and thesis) is restated more specifically with an abbreviated version of the explanation of the findings to summarize the conclusion.

Writing Conclusions

Questions	Examples
1. What was investigated? (Describe the problem statement)	The relationship between the age of compost used in soil and the growth, health, and quality of the leaves of tomato plants were investigated.
2. Was the hypothesis supported by the data?	The data appears to support the hypothesis that the growth, health, and leaf quality of tomato plants would improve with increases in the age of compost mixed with soil.
3. What were the major findings?	As the age of the compost increased the health, quality of the leaves, and the mean height of the tomato plants increased. The mean height of plants grown in soil with compost aged for six months was greater than the control group, with plants exhibiting similar health. More plants grown in soil with six month old compost exhibited poor leaf quality than in the control.
4. How did your findings compare with other researchers?	No similar studies were found relating the age of compost to the growth of tomato plants.
5. What possible explanations can you offer for your findings?	As the compost decomposes, nutrients needed by the plant may be released thereby improving the growth of the plant.
6. What recommendations do you have for further study and for improving the experiment?	This experiment could be repeated with an increased number different ages of compost. Measurements of soil temperature may help to understand what is happening to the compost.
7. What are some possible applications of the experiment?	The use of compost aged for longer than six months will improve the growth of tomato plants.

Writing Conclusions

Questions	Examples
1. What was investigated? (Describe the problem statement)	
2. Was the hypothesis supported by the data?	
3. What were the major findings?	
4. How did your findings compare with other researchers?	
5. What possible explanations can you offer for your findings?	
6. What recommendations do you have for further study and for improving the experiment?	
7. What are some possible applications of the experiment?	

DESIGNING STUDENT INQUIRY-BASED LABORATORY INVESTIGATIONS CORRELATED TO THE CBC AND THE FLORIDA SUNSHINE STATE STANDARDS

Title: _____

CBC (Components, Competencies, Objectives): _____
FSSS (Strands, Standards, Benchmarks): _____

Science Concept (s): _____

Problem Statement (Question): _____

_____

_____

Potential Hypothesis (es): _____

_____

_____

Procedure:

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

Number of Trials: _____ **Control Test:** _____

Variables: _____

Manipulated Variable: (if not comparative or observational investigation) _____

Responding Variable: _____

Variables Held Constant: _____

Data (Tables, Graphs, Charts, etc.) _____

Data Analysis and Interpretation_____

Conclusions: (Use Seven Question Conclusion Form)_____

Resources: (Bibliography, Interviews, etc.)

COMPONENTS OF EXPERIMENTAL DESIGN

Title:	An **Experimental Diagram** summarizes the problem statement, hypothesis, manipulated variable(s), responding variable(s), constant variables, number of tests and trials, and the control.
Type of Experiment	Describe the design of the experiment as a Descriptive, a Comparative, or an Experimental Variable type of experiment.
Problem Statement	A problem statement is a question about possible relationships between manipulated and responding variables in a situation that implies something to do or try.
Hypothesis:	A hypothesis is the investigator's prediction of a possible specific relationship between a manipulated variable (cause) and a responding variable (effect) that provides a testable answer to the problem.
Manipulated Variable:	Manipulated variables are the factors that can be changed by the investigator (causes). Manipulated variables are also called the independent variables.
Responding Variable:	Responding variables are the observable factors of an investigation the result or happen (effects) when a manipulated variable is changed by the investigator. Responding variables are also be called the dependent variables.
Experimental Tests:	Apply the experimental procedure to a specific aspect of the manipulated variable.
Number of Trials per Test:	The trials are the number of experimental repetitions, objects, or organisms tested during each test of a manipulated variable.
Control Test:	A control test is the separate experiment that serves as the standard for comparison to identify experimental effects, changes of the responding variable resulting from changes made on the manipulated variable.
Variables Held Constant:	Constant variables are the other identified manipulated variables in the situation that are kept or remain the same during the investigation.

Experimental Diagram

Title:	
Type of Experiment	
Problem Statement	
Hypothesis:	
Manipulated Variable:	
Responding Variable:	
Experimental Tests:	
Number of Trials per Test:	
Control Test:	
Variables Held Constant:	