

## EXPERIMENTAL DESIGN SCORING EXPLANATION

Experiment: a process in which some treatment is applied to a number of subjects and its effects observed

### 1. STATEMENT OF PROBLEM

Non-yes/no question that defines the topic of the experiment

It is NOT the same as the topic area or assigned problem

It defines the specific relationship you wish to study

It can be a statement or question, but not a yes/no question

It must be clearly testable with the materials provided

### 2. HYPOTHESIS

A statement predicting the relationship between the independent and dependent variables that can be tested

The hypothesis must predict a relationship or trend

It must take a stand

It needs to include the independent and dependent variables

If (the independent variable) (increases/decreases) then (the dependent variable) will (increase/decrease/remain the same)

A brief rationale should be included

### 3. VARIABLES

Factors that can change in an experiment

Independent variable (IV): the manipulated variable

A variable that is purposely changed or manipulated

The IV should be operationally defined (units!)

Operationally defined: clearly stating how a variable will be measured or described

You should test 3-5 levels of the IV

Levels of the independent variable: the values of the independent variable that one tests

Dependent Variable (DV): the responding variable

The variable that changes in response to the changes in the independent variable

The DV should be operationally defined

Constants (Controlled variables)

Factors that don't change in the experiment: factors with a fixed value

These can be other possible independent variables that you are choosing to hold constant

At least 4 should be listed

### 4. EXPERIMENTAL CONTROL: the standard of comparison (SOC)

A trial used to detect and measure hidden variables

The control can be a zero treatment, a level of IV, or an outside control

The control is often specific to the goal of your experiment

You should include a rationale for why you choose the control you did

## 5. MATERIALS

A listing of all the equipment used in an experiment

The materials should be listed separately from the procedure

It should include everything you use, but not any extra materials

You should include model numbers and brands where appropriate

## 6. PROCEDURE

A listing of exactly how one did an experiment

It should contain enough information so another could repeat the experiment

You only need to write for one level of IV, then say repeat steps \_\_\_\_\_

You should have repeated trials at each level of the IV

Diagrams are extremely helpful

Qualitative data: data based on a non-standard scale

Quantitative data: data based on measurement

## 7. QUALITATIVE OBSERVATIONS

The stuff you notice during the course of the experiment

They should include a qualitative representation (description) of the data

You should include procedural irregularities

Also include any extra information that you notice but doesn't directly relate to the DV

You should include observations throughout course of experiment

## 8. QUANTITATIVE RESULTS

Data Table

A chart that displays the data collected in an experiment

Make sure the table is organized

The table should have a title

All columns and rows should be labeled including units

Use correct significant figures

Significant figures: the number of digits in a number that have meaning

Include ALL raw data

Include a summary table of important data

Calculated values should be in their own columns

## 9. GRAPHS

A pictorial representation of the data

Be sure to use an appropriate type of graph, generally a bar or line graph

Any trends in data should be represented

Graphs should have titles

All axes should be labeled including units

Use an appropriate scale

Include a figure legend to briefly explain the graph

## 10. STATISTICS

Include a measure of central tendency (mean, median, mode)

Measure of central tendency: value at the center or middle of a data set

Mean (average): found by adding all the values obtained and dividing by the total number of values

Median: the middle value when all the values are arranged in order of increasing or decreasing magnitude

Mode: the value that occurs most often

Include any other appropriate statistics

Measure of variation (range, standard deviation, frequency table, histogram)

Range: the difference between the highest value and the lowest value

Standard deviation: a measure of how closely individual data points are arranged around the mean

Frequency table: measure of variation for qualitative data; lists the categories in one column and the number of times each occurred in another

Histogram: a pictorial representation of a frequency table

Regression line – Line of best fit showing the trend of the data

Percent error: measure of how close an experimental value is to the expected value

## 11. ANALYSIS OF RESULTS

An explanation of the data obtained including any trends found and relevant statistics

Include a discussion of what the data means

Discuss trends and what they mean

Include statistics and what they mean

Discuss unusual data points, include why they may have occurred and whether they are statistically significant

Do not just restate the data, discuss it.

It's ok to throw out ideas that you aren't sure of

## 12. POSSIBLE EXPERIMENTAL ERRORS

A statement indicating any sources of error in an experiment

Random Error: error introduced because of limited precision of instruments. It can be either higher or lower than correct value

Mess-up Error: error introduced into an experiment because of a known mistake done by the experimenter or because of a faulty/poor procedure

Systematic Error: error introduced because of faulty equipment. It is normally only higher or lower than correct value

This is a separate section from analysis of results.

You should discuss important information about data collection

Give possible reasons for errors

Discuss the possible effects of errors on the data

### 13. CONCLUSION

A statement describing the purpose, major findings, and explanation of findings of an experiment

A one paragraph summary of your experiment

You should include the purpose of doing the experiment

You should restate your hypothesis

You should evaluate your hypothesis according to the data

Does the data support your hypothesis?

Give reasons to accept or reject your hypothesis

Don't include lots of numbers in your conclusion

### 14. RECOMMENDATIONS FOR FURTHER EXPERIMENTATION AND PRACTICAL APPLICATIONS

Give at least one suggestion to improve the particular experiment you did

(Other than we need better equipment or more time)

List another possible experiment to examine your same hypothesis

Give at least one suggestion for a future related experiment

Give at least one practical application for the specific experiment done