Virginia Tech
Biological Systems Engineering

Guide to Laboratory Reports

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Contents

Introduction

Purpose of this guide

You can expect to encounter a variety of writing types in your career. But whether writing a long project report, research paper, or brief internal project summary, there are common elements in all technical writing. This guide provides a template for use in BSE for writing laboratory reports. It also covers basic concepts and elements that are common across a wide range of technical writing and types of reports. While faculty may have different expectations for content and format for specific laboratory or project reports, the elements outlined in this guide will generally be applicable and should be followed throughout your career in BSE.

Why do we write laboratory reports?

As a scientist and engineer, your work will have little meaning unless you can communicate the results to colleagues, clients, and/or the general public. Writing laboratory reports gives you practice for your future career as an engineer or researcher when you will write project reports or peer-reviewed research papers. Because the methods and equipment we use and the assumptions we make affect the results, these important details need to be documented. The results need to be clearly presented and discussed and the conclusions should be concisely stated.

Basic Writing Guidelines

It is important to distinguish between technical writing (scientific/engineering) and creative writing. Creative writing seeks to create an image. The goal of technical writing is to communicate knowledge as clearly, and with as little ambiguity, as possible. Do not try to make your writing sound sophisticated, just make your point in plain language and move on. Remove the fluff. While your writing should follow good style (e.g. sentences with varying length and structure) to make it readable and understandable, above all, your writing must be accurate, concise, and consistent to avoid ambiguity. Simplify terminology and descriptions by defining terms and then using them consistently. In contrast, creative writing encourages the use of different words in describing the same thing. Use appropriate headings and sub-headings to make the organization and content clear and be consistent in all aspects of the document, in terminology, structure, and format. Other comments are as follows:

- Use 12-point font, 1-inch margins, and 1.5-line spacing, except in figures and tables and the associated captions.
- Write in the past tense. The activities you are discussing occurred in the past. An exception to this is when you discuss things that exist in the present (e.g. The Stroubles Creek watershed is 25 km^2.).
- Correct English grammar is expected at all times. Do not use slang.
- Spell check your report.

- Pages must be numbered.
- Use the equation editor in Word to enter equations.
- Use consistent formatting (e.g. all section headers are bold or italic).
- All material other than text should be in a referenced figure, table, or appendix. Do not include loose material attached or inserted for the reader to figure out.
- Generally, technical writing is in the third person; do not use I, we, etc.

There is no set length for laboratory reports. The report should concisely present a detailed description of the work performed and should thoroughly discuss the results, such that the conclusions are clearly supported. Do not ramble on just to add length. Remove the fluff.

General Report Format

The style and format for different components in technical writing differ to some degree by discipline. Whatever your specific field of work, find and follow the technical style for that discipline; the technical style for BSE is specified by ASABE (http://www.asabe.org/media/19670/asabe_guide_for_authors.pdf). During your career in BSE, you will be expected to follow the guidelines outlined in this report for all assignments. Your laboratory report, and scientific reports in general, should be written following the format in Table 1.

Table 1. Elements of a report.

Report Element	Purpose
Title Page	Protects and displays laboratory title, due date, your name
Abstract or Executive Summary	Summarizes the content of the report
Introduction	Provide background information and rationale for the work. Ends with the laboratory objectives
Methods	Provides detailed description of methods and equipment used
Results	Presents the uninterrupted data
Discussion	Explores the findings of the work
Conclusions	States major findings related to the objectives
References	Presents full citations for any outside materials
Appendices	Provides supporting documents or information not included in the main report

Title Page

The title page both protects the report and displays the report title, date of submission, and author(s). The date of the laboratory exercise, overseeing professor, course name, and exercise number are optional additions. The cover page is the first page of your document, but should not be numbered.

Abstract or Executive Summary

An abstract or executive summary is typically one of two paragraphs and it is the first section of the report, placed before the introduction. Abstracts are typically written for laboratory exercises, whereas an executive summary is used in reports such as for your senior design project. In some styles, the abstract is on a separate page between the cover page and the bulk of the report. The abstract proves the most important details of the work: it is a concise statement of the entire work from Introduction of Conclusions. As a general outline, the abstract should have one introductory sentence, one sentence stating the laboratory objectives, two to three sentences on the methods, two to three sentences on the results, and one to two sentences on the conclusions. In no way should the abstract be copied and pasted from other sections. The following is an example if an adequate abstract. However, there are several remaining questions that the authors should answer in the abstract.

> *Abstract:*
>
> The purpose of this lab was to conduct a survey of a retention pond using a total station and then create a topographic map from the collected data. The topographic map created with the data distinguished the perimeter of the retention pond and its basin. The contour interval used was 0.1 feet. The landmarks within the retention pond area such as the inlet and outlet areas were added from the field sketch notes. Topographic maps such as these are useful tools for helping engineers visualize the contours of the land so that they can design the most suitable storm water systems.

What is good about the abstract:

- The authors state their purpose in the first sentence.
- Here, the authors are able to tell the reader immediately the final outcome (or result) of the exercise (creation of a topographic map from collected data).
- Information regarding their methods is given, and the important parameter (the contour interval) is specified.
- Statements regarding how the output will be used (or why it is important) are given.

Remaining questions:

- What other software package (or method) was used to create the topographic map?
- Why was a contour interval of 0.1 feet necessary? Were others inadequate?
- How were the landmarks added from field sketch notes?
- Can anything be said about the overall size or location of the retention pond?
- Did the topographic map reveal any unique features that will be of major importance to the design of a storm water system?

Introduction

The role of the introduction is to describe the problem or the importance of the work (i.e. why should anyone care about this) and then describe the objectives of the research at the end. The introduction should provide the background, justification, and goals that will be developed in the report.

The following example is of a good introduction. See the description of the good points of this introduction and the remaining questions below.

> *Introduction:*
>
> The corn harvest time is a critically important time of the year for farmers. During harvest, a machine will cut the stalk and take the top part of the plant into the threshing chamber. This separates the grain from the stover. The stover is the vegetative part of the plant, and it may be used as a feedstock for fuel ethanol production. Although the corn grain is collected earlier in the year, the stover is usually not collected until late fall. Because of the approaching winter season, it may not be possible to field-dry the stover; therefore, this portion of the plant can be collected and transported to a plant to be processed. At the plant, the cellulose in the corn fiber is converted into glucose, which is then fermented into fuel ethanol.
>
> The ensiling process is used to convert the cellulose of the stover into fuel ethanol. This process is anaerobic so it must take place in an oxygen-free environment. During ensiling, lactic acid and sugar are produced from the starch the stover, respectively. This results in a drop in pH. Many bacteria cannot survive at this low pH. This condition stabilizes the material and allows it to be stored for long periods of time. The purpose of this experiment is to understand the ensiling process and to correlate the breakdown of plant fiber with the potential production of fuel ethanol.

What is good about the introduction:

- The background is described in excellent detail. For example, the stover is fully described, as well as the importance of stover to ethanol production. The process of ensiling and why it works is also detailed nicely.
- The purpose of the experiment is stated.

Remaining questions:

- What experiment is being performed? (this only needs to be stated briefly). More information should be provided about the objectives of this laboratory.

Methods

The Methods section describes in concise detail the methods and materials you used in the experiment. Your description should include sufficient detail that someone could replicate your study, or at least could adequately understand what you did and evaluate your results and conclusions. Data sources, methods/procedures, assumptions, equations, decision criteria, etc. should be documented. A step-by-step replay is generally not desirable ("we did…, then we did…") and this section should ***not be bulleted.*** Rather, provide a concise but complete description of the methods. The methods section should not include any specific results or reference tables or figures in the results section. Examples for how to cite methods and equipment are provided below:

Example 1: Unvented Onset Hobo Model U20 pressure transducers (0.3 cm accuracy; Onset Computer Corp.: Bourne, MA) recorded total pressure at 1-min. intervals.

Example 2: Suspended sediment concentrations were determined using ASTM Method D 3977-97 (ASTM, 2000).

Example 3: Particle size analyses were conducted following methods outlined by the United States Department of Agriculture (USDA) Soil Survey to determine sand, silt, and clay fractions (United States Department of Agriculture, 1996).

Results

The results section simply presents the data/results of the study; results are interpreted in the discussion section. Use tables and graphs to help present data in a clear manner. However, it is equally important to introduce the figure or table in the text body and reference the figure or table before presenting this information. Your results should not be one short paragraph followed by a series of graphs. It is important to consider whether the data are more suited to a table or a figure. When presenting the data, consider the appropriate number of decimal places to present, based on the resolution and accuracy of the instruments you used. For example, we cannot measure rainfall to the thousandth of a millimeter, so do not express rainfall as 10.235 mm.

Discussion

Use the discussion section to interpret and analyze the results. Given your data, what statements can you make? When results are unexpected or inconsistent, describe what you observed and present any possible explanation or interpretation you have. Discuss possible sources of error and any evidence or indication of error. It is important to avoid conjecture—do not make conclusive statements unless you can back them up. You may also want to make qualification or cautions regarding the interpretation of the results. For example, the data set may have been small, reducing your confidence in the conclusions.

The discussion section is also the appropriate place to answer any discussion questions presented in the laboratory handout. Question answers should be integrated into the discussion text: you should never have a separate section of numbered answers. Lastly, it is important to consider the next step in the study. Do you have recommendations for additional research, study, or analysis? What changes would have improved the laboratory exercise? Help future students or researchers learn from your experience.

At times, it is appropriate to integrate the results and discussion sections together. Whether or not the results and discussion are combined depend on the research. Either way is acceptable, unless otherwise stated. Sometimes it is easier to just present the results and then discuss then. Sometimes is better to combine results and discussion.

Conclusions

The conclusions are neither a summary nor abstract of the overall report, but a statement of the findings of the experiment or the exercise. The conclusions highlight the key points learned or accomplished in reference to the overall goals/objectives. Given the "evidence" you have presented, what can you conclude regarding your objectives? The type of conclusions you draw will vary with the type of laboratory conducted. For example, in an experiment, you may find that adding Enzyme A to the bioreactor did not increase the amount of end product developed. For a surveying laboratory exercise, you may conclude that it is important to take detailed notes regarding each survey point to help you interpret your data. A conclusion could also be that additional work/analysis/study needs to be done or the experiment exercise should be changed in some way to improve the results.

References

References are part of the body of the report and should be placed after the Conclusions and before the Appendices. Beware of using non-vetted resources (i.e. Wikipedia): it is much better to find a peer-reviewed journal article (e.g. Transactions of the ASABE) or an academic or government website or document. Remember to reference any manuals or standard procedures used during the exercise using a standard format. For all references in the BSE department, follow the ASABE standard format:

http://www.asabe.org/media/19670/asabe_guide_for_authors.pdf

Appendices

Necessary supporting information that would tend to disrupt the flow of the report should be placed in appendices. This includes material that is important to the report, but is supplemental, such as information not directly needed to explain the link between the objectives and conclusions. Examples include: source data, algorithms, sample calculations, macros, derivations, and other supplemental information. Information discussed in the body of the paper (e.g. data in tables and figures) should be placed in the body, NOT in the appendix. However, the appendix should be referenced somewhere in the body of the report, as shown in the example below. Information in the appendices should be organized and clearly documented. Each appendix should have a title that summarizes the content and the content should have figure or table captions. Each appendix should begin on a new page.

Example 1: Organic nitrogen was calculated as the difference between TN and the sum of the tested nitrogen species. The results of these analyses are summarized in Appendix E.

Example 2: Hardy native perennials, shrubs, and trees were planted in the CU-Structural Soil™ to promote biological uptake and processing of pollutants and water and to provide a favorable environment for the growth of beneficial heterotrophic and autotrophic microorganisms (Appendix A).

Final Touches

After all information has been collected in your report, you should review the document to check the overall appearance. Items to check:

- Spelling and grammar
- Text is written in past tense, and using the third person
- Formatting is consistent throughout the report (i.e. section headers, indentations, font, etc)
- All figures and tables are appropriately captioned and referenced in the text.
- *No floating headers:* ensure page breaks do not separate headers or captions from the respective text section, figure, or table.

Tables and Figures

Tables and figures should be included in the sequence in which they are referenced in the text. Tables and figured are each numbered sequentially (e.g. Table 1, Table 2, Figure 1, Figure 2); the table or figure number is used to reference the table or figure in the text. It is preferable to include the table or figure in the text, following the first reference to them, rather than grouping them at the end of the report. Tables and figures should be separated from the text by *two spaces* at both the top and the bottom, unless the table or figure occurs at the top or bottom of a page (e.g. immediately above or below the page margin). See Figure 1, and Table 2 for an example. If there is white space (other than the required two lines) below a figure or table, fill that area with text. *Do not leave large white spaces in the document.*

Tables and figures must be understandable in and of themselves; they must be able to "stand alone." Thus, captions, column headings, legend, etc. must be descriptive and self-explanatory. Abbreviations and other important information necessary for interpreting the table or figure should be explained in footnotes to the table or figure or in the caption.

Tables are generally used to present data. They usually should be formatted without vertical lines or boxes; horizontal lines above and below the headings and at the bottom of the table are typically sufficient. Table 2 should be used as an example for table formatting. If you have a particularly wide table, use section breaks to create a

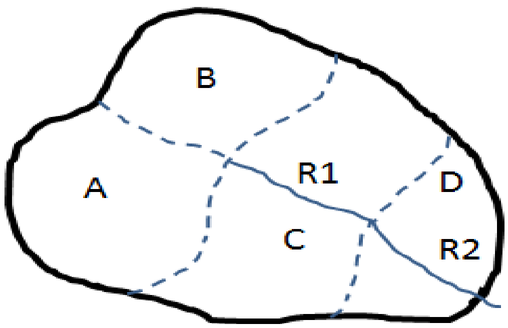

Figure 1. Map of watershed with four sub-areas (A-D) and two stream reaches (R1, R2)

landscape-oriented page in the middle of the document. To do this, insert a section-new page break before and after the table and then change the orientation of that single page to landscape. Landscape pages should be placed in the report such that the top of the page is on the side that is stapled. If your table continues onto a second page, you must have column headings on the second page and the caption should read as follows: "Table 1, cont. Rainfall simulator data from plot…"

Care should be given to how the numbers in tables are formatted. Even though computer programs, such as Excel and MatLab, report up to 14 decimal places, most of those number have no physical meaning and should not be included in the table. The number of decimal places to report for each type of data depends on the precision of the measurements you make. For example, pH may be reported to the tenths place (7.5), while conductivity may only be reported to the ones place (265). Be sure to report each number to the correct number of decimal places. In any individual column of numbers, align the numbers based on the decimal point or right-justify the numbers. Realize that Excel right-justifies numbers, but left-justifies text, so make sure column headings line up with the correct number.

Table 2. Discharge and head measurements for the vee notch weir

Discharge #	Head loss across manometer, Δh, ft.	Orifice discharge, Q_o, cfs	Water depth, H, ft.	Weir discharge, Q_{vw}, cfs
1	0.02	0.03	0.16	0.03
2	0.12	0.07	0.22	0.06
3	0.25	0.10	0.26	0.09
4	0.46	0.14	0.30	0.12

Keep in mind that table captions go <u>above</u> the table and should be left-justified. Figure captions go <u>below</u> the figure. ALWAYS! Figures in a report should not have titles (as opposed to figures for a presentation); the caption should explain the figure. The text in the figures and tables should be as large as the report font (roughly 12-pt).

Tables/figures/equations must be referenced in the text. This reference can be as follows:

1. direct… *"… the runoff values shown in Table 3 are…"*
2. or indirect… " *… the runoff values (Table 3) are …*"

Note, it is not necessary to specify the location of the table/figure/equation (e.g. table 3, on the next page) as the table/figure/equation number is used to help guide the reader to the appropriate item.

Guide to plots

Graphs and plots are considered a figure and should follow the number and formatting specified in the previous section. Additionally, use the following guidelines when creating a graph or plot for your report:

- Both axes should always be labeled with the variable and units [e.g. Time (min.)].
- When plotting data points, only use straight lines between data points; you only know the points you measured and should not interpolate results between these points.
- Trend lines should not be included on plots unless explicitly asked for in the assignment.
- There is no graph title included on the plot; this is the purpose of the caption.

Equations

Equations are generally included in the methods section as they help support the calculations used to derive your results. Equations should be typed in using Word equation editor, or similar program. All equations should be referenced sequentially, referenced in the text prior to use, and should explain all variables involved. As seen in the example, below, the equation and explanation of variables form a proper sentence through the use of colons and semicolons.

Example:

The excess shear stress equation (Equation 1) is frequently used to estimate the erosion rate of cohesive soils:

$$\varepsilon = k_d\left(\tau_a - \tau_c\right)^a \tag{1}$$

where, ε = erosion rate (m/s);
k_d = soil erodibility coefficient (m^3/N-s);
τ_a = applied hydraulic boundary shear stress on the soil (N/m^2);
τ_c = soil critical shear stress (N/m^2); and,
a = an exponent typically assumed to be 1.

Numbers

Use an appropriate number of significant digits for all numbers. This always depends on the instrument with which the measurement was made or your confidence in the accuracy of the numbers. Use the following guidelines for numbers within the report text (as opposed to tables or figures):

- Spell out numbers one through ten and two-word fractions that do not follow an integer (e.g. one-half hour).
- If you need to start a sentence with a number, spell it out. It is better to avoid this situation by rewriting the sentence.
- If a unit of measure describes a noun, separate the number and noun with a hyphen (e.g. eight 30-m stream reaches vs. each stream reach was 30 m)
- Use numerals for date, time of day, pages, figures, measurements, etc. (e.g. September 21, 2007; Table 1; 3:1 side slope; 6-ft. bottom width; Sample 1)
- When providing a percentage, use a numeral, followed immediately by the percent sign (e.g. 45%), unless the percentage starts the sentence (Forty-five percent of voters…)
- To express numbers on the order of 10^6 or more, it is acceptable to use a number followed by the words "million" or "billion," such as $3.4 billion.
- Do not use any punctuation or spaces for integers with two to four digits (e.g. 25, 469, 8632, 30,987)
- For numbers less than 1.0, include an initial zero (e.g. 0.56, 0.2 not .56, .2)
- Be aware that the international standard is to indicate a decimal place with a comma and a thousands place with a decimal point (e.g. 0.65 is 0,65; 45,988.2 is 45.988,2)

Units and Abbreviations

The first time you use an abbreviation, you should spell it out [e.g. The United States Environmental Protection Agency (USEPA) regulates discharges of…]. It is important to be consistent in the use of units (generally SI). Typically, there is a single space between the number and the unit (e.g. 20 ml). The exception to this is the degree symbol and percentage symbol (e.g. 25°C, 45%). To indicate a number raised to a power of two or three, use a superscripted numeral instead of the word "squared" or "cubic" (e.g. m^2 not sq. m).

The SI system (International System of Units) uses symbols instead of abbreviations; therefore, these are treated as symbols and should not be followed by a period (except at the end of sentence, of course) or made plural using an "s" at the end. The symbols are case sensitive. The exception to this is the symbol for liter, which may be written as "l" or "L", since the lower case symbol is easily confused with the number "1". For English units, there are few standard abbreviations or symbols. Table 3 lists common abbreviations that can be used. You do not need to spell out the units before you use the abbreviation as these abbreviations are generally accepted within the technical community.

Table 3. Acceptable abbreviations for English units and symbols for metric units.

English Units Unit of Measure	Abbreviation	Metric Units Unit of Measure	Symbol
acre	ac.	bit	b
barrel	bbl.	byte	B
cubic	cu.	Celsius, Centigrade	C
cubic feet per second	cfs	cubic centimeter	cc or cm^3
dozen	doz.	centimeter	cm
Fahrenheit	F., F	cubic meter per second	cms
fluid ounce	fl. oz.	gigabyte	G,GB
foot	ft.	gram	g
gallon	gal.	hectare	ha
grain	gr.	Kelvin	K
gross	gr., gro.	kilobyte	K, KB
inch	in.	kilogram	kg
karat	k., kt.	kiloliter	kl or kL
knot	k., kt.	kilometer	km
pound	lb.	liter	l or L
long ton	LT, L.T.	meter	m
mile	mi.	megabyte	M, MB
miles per hour	mph	microgram	mcg or µg
nautical miles	n.m.	milligram	mg
ounce	oz.	milliliter	ml or mL
pint	pt.	millimeter	mm
quart	qt.	metric ton	MT
square	sq.	metric ton	t, T
revolutions per minute	rpm	watt	W
ton	T., T	kilowatt	kW
yard	yd.	kilowatt-hour	kWh

Grammar Tips

While many engineers find writing a chore, good writing is an essential skill for your future career. Unlike creative writing, technical writing must be clear and precise. Eliminating unnecessary words and changing the sentence structure throughout a paragraph can greatly improve the readability of your work. The following examples were taken directly from student papers and illustrate common mistakes in technical writing.

Too many phrases:

Poor: The transport capacity can be looked at as the amount of energy in a stream available for the movement of sediment.

Improved: The transport capacity can be viewed as the total amount of stream energy available for sediment movement.

Poor: The Areal Nonpoint Source Watershed Environmental Response Simulation (ANSWERS) model was created to allow for the assessment of water quality at the watershed scale based on changes in land use, management, and conservation practices (Beasley et al., 1980).

Improved: The Areal Nonpoint Source Watershed Environmental Response Simulation (ANSWERS) model was created for watershed-scale water quality assessments based on changes in land use, management, and conservation practices (Beasley et al., 1980).

Poor: The bed of the channel…

Improved: The channel bed…

Poor: The depth of water applied is…

Improved: The applied water depth is…

Step-by-step methods and lengthy verbiage:

Poor: Objective 1

During the pilot study sediment concentration will be measured at 0, 200, 400, 600, 800, and 1000 mg/L. For each of these sediment concentrations, the conductivity and temperature of the solution will be varied. Conductivity levels will be set at 0, 250, and 500 μS/cm and 0, 10, 20, and 30 degrees Celsius. Each step of this study will be repeated five times in order to statistically analyze the interactions between sediment, temperature, and conductivity.

During the extended study the steps described above will be repeated but at a higher level of detail. Specifically sediment concentration will be varied by only 50 mg/L. Temperature will vary by 5 and conductivity will vary by 100 μS/cm. Also during this phase of the study, the affect of different flow velocity on sensor output will be studied within the sediment flume.

Improved: Objective 1. Determine if capacitance sensors can accurately measure suspended sediment concentration

During the pilot study, 1500 mol solutions at three different conductivities (0, 250, 500 μS/cm), 11 different sediment concentrations (0 – 1000 mg/L), and four temperatures (4, 10, 20, 30°C) will be prepared and analyzed with the capacitance sensors. The soil will be suspended using a stirring rod. Conductivity and temperature will be monitored independently of the capacitance sensors. Total suspended solids will be analyzed for each SSC using a 100 mol aliquot removed from the area around the probes to determine the exact suspended sediment concentration within the probes' measurement volume.

During the extended study the steps described above will be repeated but at a higher level of detail. Specifically, sediment concentration and solution temperature and conductivity will be varied by only 50 mg/L, 5^{o}C, and 100 μS/cm, respectively. Also during this phase of the study, the effect of five different flow velocities on sensor output will be studied using a 1 m x 0.45 m x 6 m sediment flume.

Vague writing:

Poor: A variety of storage zones are used to represent the storage processes that occur on the land surface and in the soil.

Improved: Water storage on the land surface and in the soil are represented by initial abstraction, surface retention, and soil moisture.

Poor: Research results suggest moisture content influences soil erodibility.

Improved: Research results indicate increases in volumetric soil moisture content from 20% to 50% reduce soil erodibility by a factor of three.

Poor: This assumption is valid for large rivers.

Improved: This assumption is valid for large rivers (bankfull width > 10 m).

Active versus passive verbs:

Poor: Table 1 gives a description of typical parameters in each group.

Improved: Table 1 describes typical parameters in each group.

Poor: The channel is considered to have a trapezoidal cross section with assumed banks side slopes of 2:1.

Improved: The model assumes all channels have trapezoidal cross sections with 2:1 side slopes.

Matching nouns and verbs (i.e. Does your writing even make sense?):

Poor: Daily soil moisture considers evapotranspiration, percolation, and runoff components for two soil layers (USDA, 2005). *Can soil moisture think?*

Improved: Daily changes in soil moisture are determined based on runoff and evapotranspiration and percolation rates for two soil layers.

Poor: As modeled in TR55, the first 50 m are assumed to be overland flow, followed by 50 m of shallow concentrated flow, and the remaining length is considered concentrated flow. *Can a length be a flow rate?*

Improved: As modeled in TR55, runoff occurs as overland flow over the first 50 m of the flow path, as shallow concentrated flow for the next 50 m and as concentrated flow for the remainder of the flow path.

Poor: Components of the pesticide model include daily estimates for soluble and attached particles including leaf wash off, decay, and transport through the soil matrix. *Huh?*

Improved: Components of the pesticide model include leaf wash off, decay, and transport through the soil matrix for daily mass balances of both soluble and attached pesticides.

Poor: Sediment exchange between the channel bed and flow is mediated through the assignment of bed sediment particles to layers. *Do the channel bed and the flow need conflict resolution?*

Improved: Bed sediments are represented by a series of vertical layers.

Poor: CCHE-1D allows the user a variable Manning's n value to simulate differences in surface conditions between stream bed, banks, and floodplain (Wu and Vieira, 2002). *I didn't know a computer model could give permission.*

Improved: A variable Manning's n-value can be specified to simulate differences in surface conditions between the stream bed, banks, and floodplain (Wu and Vieira, 2002).

Poor: The equation for drag force is also called Stokes' law which opposes the motion of the particle. *Can an equation oppose the motion of a particle?*

Improved: Stokes' law (Equation 1) calculates the drag force on a particle. The drag force opposes, or slows down, particle motion.

Poor: The experiment used to determine the rate of decreasing concentration plotted absorbance data over time, to determine a best line of fit. *Can an experiment plot data?*

Improved: The experimental absorbance data was plotted versus time and a best-fit line was used to determine the rate of change in concentration.

Words or phrases you should never use:

Poor: In order to

Improved: To

Words or phrases you should be careful when using:

Data: This noun is ***plural***.

For example, The data indicate streambank retreat is a major sediment source.

Be: Use of this word means your verb is passive. Try to make it active.

Variety, multiple, several: State exactly how many - three? seven? – or list them individually.

That: This word is greatly overused. Reread the sentence without the "that" to see if you really need it.

This: Do not use "This" alone as the sentence subject; it is often unclear to what noun "this" refers. For example, instead of stating "This suggests increased moisture content reduces soil erodibility." state "This finding suggests…"

Colons and Semicolons

Colons and semicolons are used to join two sentences instead of a conjunction and to separate phrases in long lists, such as for explanations of equation variables (Equation 1 example). Use a colon between independent clauses if the second summarizes or explains the first. Use a semicolon between two closely related independent clauses instead of a conjunction. Examples of the proper use of each are listed below.

Specific objectives include the following:

1. Determine if capacitance sensors can accurately measure suspended sediment concentration;
2. Determine if particle size can be determined using capacitance probes; and,
3. Evaluate the feasibility of using capacitance sensors in the field for long term suspended sediment monitoring.

Li et al. (2005) found this relationship could be used to determine suspended sediment concentration; however, more research on capacitance is needed to better understand how environmental factors affect capacitance measurements.

Streambank retreat typically occurs by a combination of three processes: subaerial processes and erosion, fluvial erosion, and bank failure (Lawler, 1995).

Tests were not conducted on the upper bank of one site: crawfish burrows interfered with testing.

As discussed in McBride (1994), the flocculation of suspended particles increases with increasing cation charge and concentration; the solution cations reduce repulsion between the negatively charged soil particles.

Additional Help

Making mistakes is part of being human (even for professors!). If you have an important document, such as a job or scholarship application, have a friend who writes well and who will be honest with you review your writing. You can also find additional information at:

VT Writing Center web site

http://www.composition.english.vt.edu/wc/WC%20Home.html

Online Writing Lab

http://athena.english.vt.edu/~owl/index.htm