

## Unit One: Grammar Review

### Passive and Active Voices

The following table summarizes the most common cases of active and passive voices' examples according to the tense of the sentence:

Active	Passive	Tense
Reporters write news reports.	News reports are written by reporters.	Present Tense
Mike is baking a cake.	A cake is being baked by Mike.	Present Continuous
Jean Rhys wrote "Wide Saragasso Sea".	"Wide Saragasso Sea" was written by Jean Rhys.	Past Simple
They were decorating the hall when I arrived.	The hall was being decorated when I arrived.	Past Continuous
Lisa has recorded a song.	A song has been recorded by Lisa.	Present Perfect
They are going to knock down the old library.	The old library is going to be knocked down.	Future (Going to)
I will make it tomorrow.	It will be made tomorrow.	Future (Will)

### Examples:

Harry ate six shrimp at dinner. (active)

At dinner, six shrimp were eaten by Harry. (passive)

We are going to watch a movie tonight. (active)

A movie is going to be watched by us tonight. (passive)

The crew paved the entire stretch of highway. (active)

The entire stretch of highway was paved by the crew. (passive)

I will clean the house every Saturday. (active)

The house will be cleaned by me every Saturday. (passive)

She faxed her application for a new job. (active)

The application for a new job was faxed by her. (passive)

The teacher always answers the students' questions. (active)

The students' questions are always answered by the teacher. (passive)

Who taught you to ski? (active)  
By whom were you taught to ski? (passive)

The cleaning crew vacuums and dusts the office every night. (active)  
Every night the office is vacuumed and dusted by the cleaning crew. (passive)

Who ate the last cookie? (active)  
The last cookie was eaten by whom? (passive)

## **Articles**

Articles are the forms **a**, **an**, and **the**, it is a part of speech that comes before a noun.

### **The Indefinite Articles (a/an)**

- The form **a** is used before a word beginning with a consonant, or a vowel with a consonant sound:

**a** plane   **a** one-way

- The form **an** is used before words beginning with a vowel (a, e, i, o, u) or words beginning with a silent **h**:

**an** iron   **an** hour

- ❖ Use of the indefinite articles:

The indefinite articles (a/an) are used:

- (1) Before a singular noun which is countable (i.e. of which there is more than one) when it is mentioned for the first time and represents no particular person or thing:

The four centers lie in **a** plane.

- (2) With a noun complement:

The noun complement is a word or phrase used to complete a grammatical construction. There are two kinds of noun complements; subject complement and object complement.

A subject complement is a predicative expression that follows a linking verb (the term linking verb is used to refer to verbs that describe the subject or link the subject to some complement such as a predicate adjective or predicate noun) and that completes the subject of the sentence by either renaming it or describing it.

The subject complement is bold in the following examples:

The lake was a **tranquil** pool.

It was an **earthquake**.

The object complement is a noun, pronoun, or adjective which follows a direct object.

The advisor sent him a **paper**

### **The Definite Article (the)**

The definite article (**the**) is used with countable nouns in the singular/plural and uncountable nouns in the meaning “mentioned earlier.”

❖ Use of the definite articles:

The definite article (the) is used:

- (1) In generalizations with singular countable nouns to refer to a class of things.

**The brain** is a complex biological system.

- (2) Before the superlative degrees of adjectives, ordinal numerals, and specifics (such as same, only, principal, etc.).

**The best** results were obtained during **the second** experiment.

**The only** paper on this problem was published ten years ago.

(3) With the names of unique objects.

**The Universe** is thought to contain  $10^{11}$  kilograms of matter.

(4) With the names of theories and devices modified by a proper name used as an adjective:

The Dirichlet problem, the Celsius scale

BUT: when a proper name is used in possessive form, no article is used:

Dirichlet's conditions

Note:

The definite article “the” is not used with the first mention of the constructions that denote part of a whole:

a molecule of hydrogen

## Unit Two: Linking Words

When you are writing, it is important that the connections between your ideas are made very clear. The following linking words or phrases can be used to provide your reader with indications about how ideas are connected in your writing:

- 1- **Addition**: to add to what has been previously stated: **In addition, furthermore, also, and, as well as.**
- 2- **Condition**: to provide a condition to what has been previously stated: **if, in that case, unless...**
- 3- **Sequence**: to show sequence: **First, firstly, second, secondly, third, thirdly, next, last, finally.**
- 4- **Illustration**: to provide examples: **for example, for instance, to illustrate, to demonstrate.**
- 5- **Cause**: to provide reasons for what has been stated or has occurred: **For, because, since, as, because of, to cause**
- 6- **Effect**: to provide effect of what has been stated or has occurred: **So, as a result, as a consequence, therefore, thus, consequently, hence, to result from, due to, as a result/consequence of, to result in, to affect.**
- 7- **Contrast**: to show how things are different: **However, nevertheless, nonetheless, still, although, even though, though, but, yet, despite, in spite of, in contrast, in comparison, while, whereas, on the other hand, on the contrary, but.**

8- **Comparison:** to show how things are similar: **Similarly, likewise, also, too, as, just as, like , just like, similar to, be similar to/ the same as, be alike, not only...but also, to compare to/with**

9- **Emphasis:** to put forward a point or idea more forcefully: **Undoubtedly, indeed, obviously, generally, admittedly, in theory/fact, particularly, especially, clearly.**

10-**Summary:** to sum up what has been previously stated: **in conclusion, in short, to sum up, in summary, to conclude.**

**Example:**

Insert appropriate connective words in the following sentences?

Our state's correctional system is plagued with problems. (a) -----(example) , high officials increase their personal wealth by awarding building and catering contracts to disreputable companies in return for bribes .

(b)----- (addition) , promotions within the system are made on the basis of politics , not merit. (c)----- (effect) , the system is filled with people at the top who know little about what they are doing. (d)----- (addition) , careless security measures , allowing trusted inmates to control certain operations of the institution , are part of the growing problem .

But one increasing tendency in particular is doing harm to the system's image and efficiency. This is the tendency of officials who are charged with important tasks and who make faulty decisions to cover up their mistakes. (e)----- (conclusions) , one would think that amid all the strife some effort would be made to rectify these problems , but a seemingly dogged determination to resist change overshadows the system.

## Unit Three: Punctuation

Punctuation is simply about a series of conventions that make it easier for readers to follow your train of thought. The following sections give the rules how to use punctuations correctly:

### 1- Full Stops

Full stop is round dot written at the end of sentence and indicates the end of a complete thought.

Example:

There are several techniques available for enhancing the stability of embankments.

### Notes:

- Make sure that the letter following a full stop is always a capital letter.
- Avoid using too many commas in your writing.

### 2- Commas

Commas are used to divide up groups of words within a sentence. The main function of the comma is to:

- Break up parts of longer sentences - for example:

**After the main points had been presented, the students were asked for their comments.**

The comma in this example neatly divides the meaning into two parts. If there were no comma, the reader would read, “presented the students...” As a word group, and this would not make sense without re-reading for clarification.

- **Present items in a list.** For example:

I would like to **watch the video, take notes, and then be ready to ask questions.**

The entree includes **chips, salsa, and a beverage.**

- **Used between independent clauses (complete sentences) joined by a coordinating conjunction: for, and, nor, but, or, yet, so.**

My family went to see the live taping of Ru Paul's Drag Race, **but** I stayed home with the flu.

- **Used with words or phrases that give more information about another word.**

For example:

Therefore, **in order to represent structural problems realistically,** some forms of nonlinear relation must be used.

- **Divide words which refer to the subject of a sentence.** For example:

The President of the Society, **Julie Jones,** received a standing ovation after her speech.

- **Separate introductory words (a group of words before the subject of a sentence that do not form a complete sentence).** For example:

**When the rain stops,** they will go out into the site.

**Since we would be returning late anyway,** we stayed to watch the sunset.

- **Punctuate certain relative clauses (i.e. parts of a sentence beginning with 'who', 'which', or 'whose').** For example:

The College, **which is located in the center of Canterbury,** has an excellent academic reputation.



• **Separate paired adjectives that describe a noun.** You need comma between adjectives that could go in any order—they’re no cumulative and could be separated by the word “and.” Do not use a comma between adjectives that need to be in a particular order. For example:

They serve cheap delicious meat. (Incorrect)

They serve **cheap, delicious** meat. (Correct)

3- **Colons** : should be used only to:

❖ **Introduce a list.** For example:

An essay usually includes the following components: **an introduction, a main body of text, and a conclusion.**

❖ **To show a link between the units of meaning, like a hinge.** For example:

The results of the survey were very clear: there was a need for a change in policy.

❖ **Never use a colon after a verb that directly introduces a list.**

The things on my mind are: papers, grades, and finals. (Incorrect)

The things on my mind are the following: papers, grades, and finals. (Correct)

4- **Semi-colons** are extremely useful in long sentences, but be careful not to over-use them. They are typically used as follows:

➤ **To provide a break in a sentence, while showing the relationship between the two parts.** For example:

He ran down the stairs; he reached the door; he opened it.

➤ **To express an idea which is too short to merit a new sentence.** For example:  
Wherever possible, students should try to organize their academic work by using ‘planning tools’; **these can help to clarify ideas.**

- **Help to avoid confusion between items in lists where there are already commas.**

For example:

She traveled to **Sao Paulo, Brazil; Seoul, South Korea; and Nairobi, Kenya.**

- **In some cases semi-colons are followed by linking words,** as in:

They were unsure about the outcome of the assignment they were about to undertake; **nevertheless,** they would try their best.

## 5- Hyphens

Hyphens are used to form compound words or join word units.

- **Use hyphens with compound numbers from twenty-one to ninety-nine and with fractions used as modifiers (adjectives).**

Three thousand five hundred and **sixty-seven** students

**Two-thirds** majority (vs. “two thirds of the voters”)

- **Use hyphens in a compound adjective only when it comes before the word it modifies.** Examples:

A **well-liked** author (an author who is well liked)

A **well-known** actor (an actor who is well known)

## 6- Apostrophes

Apostrophes should be used:

- **To show possession (belonging to).** For example:

**Einstein's** theory (meaning “The theory of Einstein”)

That pen is **Simon's**.

**Jasmine's** examination papers

The **students'** belongings ... (plural noun)

**Psychologists'** theories have suggested ... (plural noun)

## Unit Four

### Improve Your Paper by Writing Structured Paragraphs

In academic writing, effective paragraphs serve as building blocks to construct a complex analysis or argument. Paragraphing helps readers to understand and process your ideas into meaningful units of thought.

- **What do paragraphs do?**

Imagine reading this page without paragraph breaks. Paragraphs create order and logic by helping your reader recognize the boundaries where one point ends and another begins.

- **How long should a paragraph be?**

In a first draft, it may make sense to set a goal for length. For example, you can set a goal of writing four to six sentences per paragraph: in that number of sentences you can announce an idea, prove that idea with evidence, and explain why this evidence matters by linking it to the overall goal of your paper.

You will generally read and write **longer** paragraphs in academic papers. However, too many long paragraphs can provide readers with too much information to manage at one time. Readers need planned pauses or breaks when reading long complex papers in order to understand your presented ideas. Remember this writing mantra: "Give your readers a break!" or "Good paragraphs give one pause!"

- **Paragraph Structure**

Most paragraphs in an essay have a three-part structure: introduction, body, and conclusion. You can see this structure in paragraphs whether they are describing, comparing, contrasting, or analyzing information. Each part of the paragraph plays an important role in communicating your meaning to your reader.

- 1- **Introduction:** the first section of a paragraph; should include the **topic sentence** and any other sentences at the beginning of the paragraph that give background information or provide a transition.
- 2- **Body:** follows the introduction; discusses the controlling idea, using facts, arguments, analysis, examples, or other information.
- 3- **Conclusion:** the final section; summarizes the connections between the information discussed in the body of the paragraphs and the paragraph's controlling idea.

**Example:**

The following paragraph illustrates this pattern of organization. In this paragraph both the topic sentence and the concluding sentence (printed in boldface) help the reader keep the paragraph's main point in mind.

**Scientists have learned to supplement the sense of sight in numerous ways.** In front of the tiny pupil of the eye they put, on Mount Palomar, a great monacle 200 inches in diameter, and with it see 2000 times farther into the depths of space. Or they look through a small pair of lenses arranged as a microscope into a drop of water or blood, and magnify by as much as 2000 diameters the living creatures there, many of which are among man's most dangerous enemies. Or, if we want to see distant happenings on earth, they use some of the previously wasted electromagnetic waves to carry television images which they re-create as light by whipping tiny crystals on a screen with electrons in a vacuum. Or they can bring happenings of long ago and far away as colored motion pictures, by arranging silver atoms and color-absorbing molecules to force light waves

into the patterns of the original reality. Or if we want to see into the center of a steel casting or the chest of an injured child, they send the information on a beam of penetrating shortwave X rays, and then convert it back into images we can see on a screen or photograph. **Thus almost every type of electromagnetic radiation yet discovered has been used to extend our sense of sight in some way.**

### **Another sample paragraph**

**Unfortunately, to map the entire reticle with a single measurement, a 12 in. beam expander is needed.** With such a large optical system, the expander must be held rigidly, not allowing it to tip or tilt. Since the UW-CMC mount must remain vertical to be effective, it cannot be used in this scenario. Consequently, the application of this mount is limited. **Thus, a number of new designs have been proposed by industry to address the alignment issues and provide for other options, such as automated handling.**

## Unit Five

### How to Write a Technical Report: Introduction

Writing should be in paragraph form, not in outline form. Remember the content of a report must be complete and should observe the ABC's of technical writing (accuracy, brevity, clarity). Length alone is not an indication of a report's worth.

#### ➤ Units, Equations, and Calculations

Equations, numbers, and units are common in technical documents. Their use should be consistent and follow accepted standards. A few pointers are listed below:

- ❖ When written in the text, numbers ten or less should be written out. For example: **ten** experiments were conducted.
- ❖ Give units with each parameter and number that you report. For example: **stress units (kN/m<sup>2</sup> or kPa, MN/m<sup>2</sup> or MPa); Load units (N, kN, ton,..); Area units ( cm<sup>2</sup>, m<sup>2</sup>,...).**
- ❖ Use appropriate significant figures. Do not give more significant digits than can be justified by the accuracy of the applicable test or measurement. When appropriate, give an appropriate tolerance associated with the number. For example:  
The applied stress was found to be **100.2222222 kPa**. (Incorrect: insignificant digits).  
The applied stress was found to be **100 kPa**. (Correct).
- ❖ Whenever a formula is presented, clearly define each parameter and its units.
- ❖ When several equations are used, they should be numbered sequentially along the right-hand margin.
- ❖ It may not be necessary to show all of your calculations. Provide sample calculations, and place these sample calculations in an appendix. Sample calculations are particularly helpful for explaining a spreadsheet.

- ❖ Except in the “laboratory notebook” format, do not place raw laboratory notes in the main body of a report. Include them as an appendix.

Shown below is an example of a properly formatted equation, in this case for the standard deviation of a linear measure:

$$\text{Std. dev.} = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n - 1)}} \quad (1)$$

Where: *Std. dev.* = standard deviation (cm),

*i* = subscript for data points,

$x_i$  = data point (cm),

$\bar{x}$  = mean of the data (cm), and

*n* = number of data points.

### ➤ **Figures and Tables**

Engineers are accustomed to using figures and tables to present information, and the use of these displays is greatly encouraged. The conventions for use of tables and figures in a document are similar, with a few subtle differences. However, before describing those similarities and differences, it is important to recognize what constitutes a table and what should be labeled as a figure. Tables are reserved for entries with rows and columns of numbers, while figures, in general, constitute everything else.

When tables or figures require landscape format, the table or figure should be oriented so that its bottom is aligned with the right-hand side of a portrait-formatted report.

Every table and figure should be labeled with: a number (for example, **Table 3** or **Figure 10**) and a title (for example, “Axial Stress vs. Axial Strain of Annealed Copper”). When referring to a specific display, the words “table” and “figure” should be capitalized, for

example **Figure 1** or **Table 2**. Titles should be placed *below* figures and *above* tables. Tables as well as figures should be numbered consecutively, and a table or figure should closely follow its citation in the text. When a table or figure cannot fit on the current page following the citation or when it requires a full page, it should be on the page immediately following the text's first citation. Two methods are commonly used for citing figures and tables, as shown in the following examples:

**“The measured compaction characteristics of the two soils are shown in Figure 1. This plot gives the relationship between the density of the soil. Soil A can be more easily compacted since it...”**

**“The compaction characteristics of the two soils are related to the density that can be achieved with a given initial water content (Fig.1). Soil A can be more easily compacted since it...”**

Formal documents usually have lists of tables and figures following the table of contents. Columns and rows in a table should be clearly labeled and show units. When appropriate, tables should describe how numbers in the columns were determined. This aspect is particularly important when spreadsheets are used to calculate values based on numbers in earlier columns of the table. Do not let row and column delineation lines detract from the presentation; they should add to its clarity and ease of use. An example of a well-formatted table is shown in Table 1.

**Table 1. Determination of a Stream's Unit Hydrograph for a One-hour Rainfall Event**



(1) Time (hrs.)	(2) Streamflow (ft. <sup>3</sup> /sec.)	(3) Baseflow (ft. <sup>3</sup> /sec.)	(4) Direct Streamflow (ft. <sup>3</sup> /sec.)	(5) Streamflow Volume (ft. <sup>3</sup> )	(6) Unit Hydrograph (ft. <sup>3</sup> /sec.)
1	110	110	0	0	0
2	110	110	0	0	0
3	122	122	0	198000	0
4	230	120	110	1026000	182
5	578	118	460	1782000	759
6	645	115	530	1530000	875
7	434	114	320	900000	528
8	293	113	180	486000	297
9	202	112	90	252000	149
10	160	110	50	111600	83
11	117	105	12	36000	20
12	98	90	8	14400	13
13	80	80	0	0	0

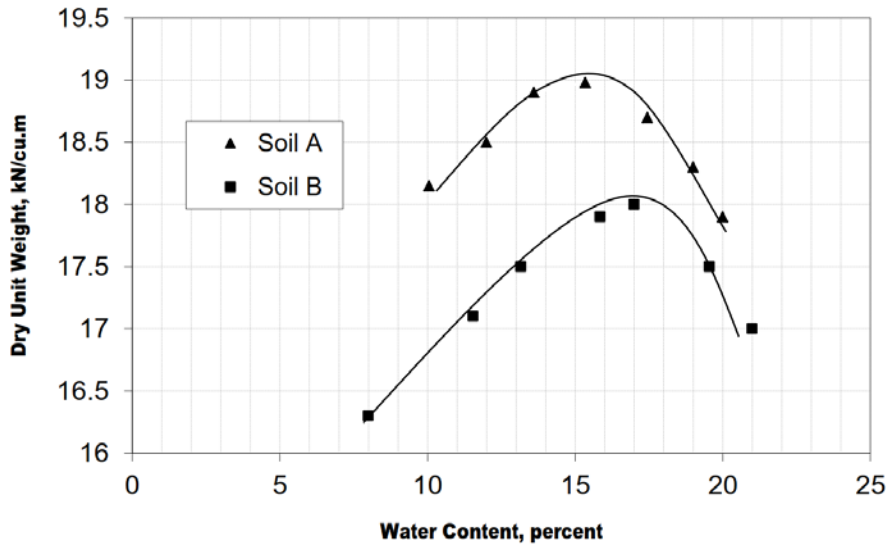
- Notes:
- Columns (1) and (2) - data obtained from field measurements.
  - Col. (3) – Baseflow: assumed to be a straight line from 122 at 3 hrs. to 90 at 12 hrs.
  - Col. (4) = Col. (2) - Col. (3)
  - Col. (5) = Area under the direct streamflow curve, approximated using area of a trapezoid. Sample calculation for line 4:  

$$Area = \left(\frac{h_1 + h_2}{2}\right) \times (base) = \left(\left(\frac{110 + 460}{2}\right) ft.^3/sec.\right) \times (1\ hour) \times (3600\ sec./hr.) = 1026000\ ft.^3$$
  - Total runoff determined by dividing total direct streamflow (sum of values in Col. 5) by area of drainage basin (4.5 sq. miles) and converting to inches.
  - Col. (6) = Col. (4)/(total runoff in inches).

For graphs, charts and the like, it is important to select the most appropriate depiction (line graph, bar chart, pie chart, etc.). Other important aspects include the following:

- ❖ Clearly label the axes of graphs and give the units within the axis labels.
- ❖ When appropriate, clearly show data points; do not just show the smoothed trend of the data.
- ❖ If a line is drawn through the data points, use a straight edge or smooth curve. Do not force the line through each data point but instead present the average trend of the data (as with “spline” curve-fitting options).
- ❖ Provide a legend if more than one data set is plotted on the same graph.

An example of a well-presented figure can be found in Figure 1.



**Figure 1. Compaction Test Results for Soils A and B**

When used effectively, figures and tables are an aid to, but not a substitute for, written text. As such, figures and tables should be cited in the text of a report, and their most important aspects should be discussed in writing. It is not sufficient to merely cite a figure without describing its significant aspects.

### ➤ **References and Citations**

You must cite any references that you have used in preparing a report. These can include laboratory manuals, technical articles, textbooks, class handouts, testing standards, web pages, and personal communications. In general, common knowledge does not need to be documented. Ideas, concepts, and words of others, whether paraphrased or not, should be documented. The act of using words or ideas of someone else without giving them credit is called *plagiarism*.

Complete references, in the form of **works cited** or **bibliography**, should provide enough information for the reader to retrieve the referenced document. In **works cited** you only list items you have actually referred to and cited in your paper. A **bibliography** lists all of the material you have consulted in preparing your essay whether or not you have actually referred to and cited the work. Typically they follow the last part of the text, before the appendices.

A consistent and appropriate format for listing and citing the references should be used. Sufficient information must be provided so that someone can locate independently the referenced materials. Shown below is an example of the MLA referencing format, where the numbers are used as the citations in the text (either in parentheses, in square brackets, or as superscripts).

1. Sowers, George. *Introductory Soil Mechanics and Foundations: Geotechnical Engineering*. New York: Macmillan. 1979. Print.
2. American Society for Testing and Materials. *Annual Book of ASTM Standards, Section 1, Iron and Steel Products*. ASTM, 1988. Print.
3. Hirrel, Timothy. "How Not to Calibrate a Hydraulic Network Model." *Journal American Water Works Association*. 100.8 (2008): 70-81. Print.
4. Kuhn, M., Personal Interview. 28 June 2007.
5. Pennsylvanai State University. "Writing Guidelines for Engineering and Science Students." November 2010. Web. 25 July 2011 <<http://www.writing.engr.psu.edu/>>.

### ➤ **Appendices and Attachments**

Appendices (sometimes called attachments) are located at the end of a document and contain information that is relevant to the content of the report, but would be too cumbersome to include in the main section. Generally, appendices are at the end of reports, while attachments accompany letters and memos. Material in the main part of the report should include information that is directly pertinent to the topic at hand. If material is so cumbersome as to disrupt the flow of the text, it might best be included as an appendix. Appendices are usually grouped by topic and labeled with letters (A, B, C,...) or capital Roman numbers (I, II, III,...).

Appendices should be cited sequentially in the text, matching the order that they appear at the end of the report.

## Unit Six

# LABORATORY REPORTS

This report format emphasizes laboratory methodology and the computation, presentation, and discussion of laboratory results.

### **Report Format**

Typically, formal laboratory reports include all of the elements discussed in the sections below. Short or informal laboratory reports omit the letter of transmittal, the table of contents, the executive summary, and the list of figures and tables. Individual instructors may have special guidelines for particular reports.

**1. Letter of Transmittal:** In some businesses, a letter of transmittal will usually accompany engineering reports, documents, and drawings. The sender and receiver of the report will usually keep copies of the transmittal letter in their files as a “receipt” or record that the report was actually sent and received.

As a minimum, the letter will give the title of the report and the number of copies that are being sent. In addition, a transmittal letter should include a brief description of the project scope, a description of your association with the project, and a concise summary of the results and conclusions or recommendations. A letter of transmittal can generally be

limited to one page. Although in business practice it is usually separate from the report (a “cover letter”), it is often placed inside your report behind the report’s cover. This placement will aid in gathering, grading, and distributing the reports.

**2. Title Page:** The title page includes the title of the experiment, test, or project; the course number, section, and name; the school and location; the name of your laboratory and instructor (Submitted to:); your name (Submitted by:); and the names of your laboratory partners (Laboratory work performed by:); the date(s) of the laboratory experiment, and the date the report will be submitted.

**3. Table of Contents:** For reports longer than 20 total pages or so, a table of contents is included that lists the various sections and appendices with their page numbers.

**4. List of Figures and Tables:** For reports with numerous tables and/or figures, a list of tables and a list of figures should be included that gives the label, title, and page number of each figure and table.

**5. Body of the Report:** A heading should precede each section of a report. Headings and sub-headings should have a consistent style throughout your report. The text of your report should include the following sections:

**a. Executive Summary:** This non-technical abbreviation of the report addresses a managerial or executive audience. It should include a brief description of the purpose, methods, and findings of your work.

**b. Introduction:** This section states the objective of your laboratory work (or project) and the engineering significance of the objective. It may also summarize the contents of the report.

**c. Background:** This section presents the context for your laboratory work. Although the following items may not be appropriate for every report, they could give you some ideas for this section:

- The governing engineering or scientific principles of the laboratory test.
- Engineering theory applicable to the experiment.
- Possible uses in engineering practice for the materials, models, or devices being tested.
- Possible uses for the laboratory results in engineering practice.
- Historical background of previous laboratory work related to your current work.
- Relationship between laboratory test and the engineering problem to which it will be applied.
- The background of the related engineering project to which the laboratory results will be applied. This could include the following:
  - The scope of work related to the project,
  - A historical account of events leading to the current investigation,
  - A general layout or description of the project, and
  - A review of existing conditions relevant to the project.

**d. Laboratory Methodology:** This section divides into two subsections with subheadings:

- **Equipment and Materials:** Give concise specifications and descriptions of the experimental equipment and the materials, models, or devices tested, including, if appropriate, calibration dates.
- **Procedure:** Describe concisely the laboratory procedure. If your laboratory procedure is based on a published procedure, for example, ASTM or IEEE methods or laboratory notes, clearly cite the procedure and state any deviations from that procedure. For example, if you are using a laboratory manual, you should distinguish your actual procedure when it is different than the manual procedure. Except for simple tests, include a clear illustration of the test setup to help describe the procedure.

**e. Results and Discussion:** This part gives the main quantitative and/or qualitative results of your laboratory work. You should describe all significant observations and findings. For example, you should clearly describe any deficiencies or failures of the sample,

model, or device that was tested. You should refer to and describe any figures, tables, and appendices that summarize your results. You should:

- Compare theoretical and experimental results. Clearly explain the assumptions behind the theoretical or accepted values. State any ways that your experimental setup may not have met these assumptions or is otherwise deficient. Explain possible deficiencies in the theory.
- Discuss the use of your results in possible engineering situations.
- Discuss whether the observed behavior or failure of the material, model, or device was to be expected on theoretical grounds.
- Discuss the suitability of the material, equipment, or device that you tested for use in engineering situations.
- Discuss possible sources of error in your procedure and estimate their effect on the results. Give recommendations for improving the laboratory procedures or equipment.

**f. Conclusions and Recommendations:** This section directly answers the stated objectives of the laboratory work. Although the instructor will often provide specific items for discussion, the following ideas may be useful in writing your report. However, these ideas may not apply to all reports:

- Start or conclude the section with a clear statement of whether the objective was accomplished.
- Briefly explain results that “don’t look very good.”

Because they are so closely linked to the above analysis, many of your detailed conclusions and recommendations will be embedded in this section and need only be summarized in your final conclusions.

**6. Figures and Tables:** There are two recognized methods for presenting figures and tables. They can either be placed together at the end of the body of the report, or each figure and table can be placed separately immediately after it is first cited in the text.

## **7. References**

**8. Appendices:** Each appendix should be clearly labeled and must be cited in the body of the report. The appendices include the following:

- *Original data sheets.* Your raw laboratory notes and any lecture or handout notes, which should be dated and signed.
- *Sample calculations.* Include sample calculations for the results given in your report. You should clearly state your assumptions and explain each step taken in your calculations. Cite all equations, material properties, etc., properly.

## **EXAMPLES OF GRAPHS**

Using Microsoft Excel, graphs can easily be created from tables of data. However, the type of graph should be selected to emphasize the point being addressed; for example, differences between data sets, or a trend line.

- Column and bar graphs best represent the differences between data sets, where the relationship between or among the data sets may not be the important point.
- Scatter plots are best used where data points consist of pairs of values. They are best used to display trends. Excel allows you to determine a line of best fit using linear regression analysis. The result will show the linear equation, along with the coefficient of determination,  $r$  (a measure of the goodness of fit; or how well the line fits the data points).
- Pie charts are valuable for showing the relative proportions of the total attributed to an attribute.

Note that many of the standard graphs available in Excel may not be appropriate for the types of presentations made by engineers and computer scientists. Also, many of the colors available to distinguish different aspects of a graph may not show up well as differences when printed in black and white. The following sections provide examples of how graphs can be used and misused.



### **Example 1**

Table B-1 shows an Excel array of numbers, which has been plotted in Figures B-1 and B-2. Clearly the table communicates the values more precisely, and with a sense of the level of significant figures. However, a figure can provide a better feeling for the relationship among data points. Figure B-1 was created with an Excel line graph. It is an incorrect representation since the horizontal axis does not contain intervals that are consistent with the independent variable. In addition, there is no label for the horizontal axis. Figure B-2 was created with an Excel xy scatter plot, depicting the dependent vs. the independent variable. Note that the second plot shows the trend of the data accurately.

Table B-1. Relationship between time and temperature for experiment 1

<u>Time (min.)</u>	<u>Temperature (C)</u>
0	21.5
0.5	28.2
1	32.5
1.5	35.3
2	37.7
2.5	39.2
3	40.1
4	41.2
5	42.2
7	43.6
10	45.6

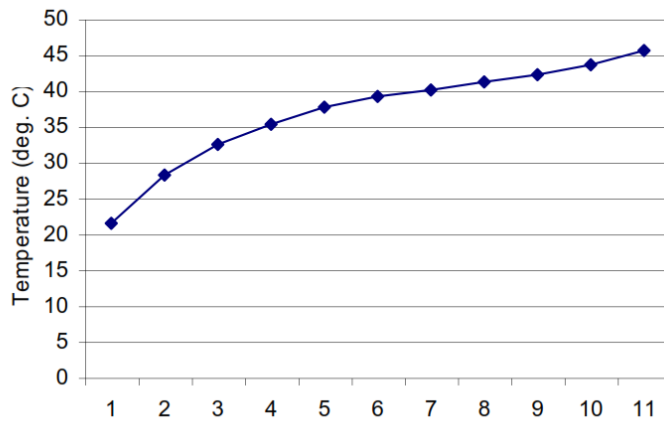


Figure B-1. Poor example of plotted data using an excel line graph

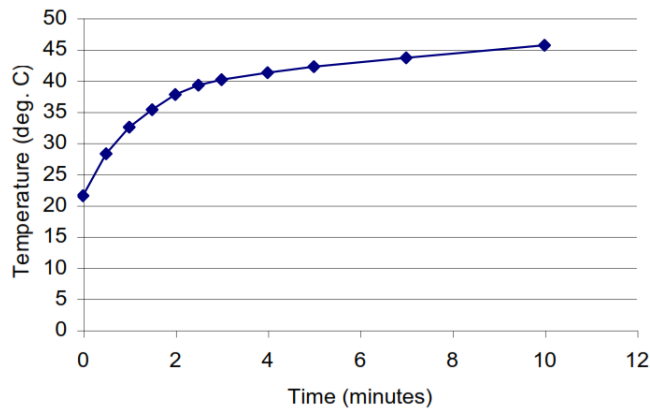


Figure B-2. Example of a properly plotted data set using an XY graph

## **Example 2**

The data points shown in Table B-2 are illustrated in three different ways in Figures B-3 – B-5. Figure B-2 does not depict the data in a meaningful way since there is not necessarily a connection between the development costs of the various components of the project. Therefore, the lines connecting the points are inappropriate. Figure B-4 represents the data better. The pie chart shown in Figure B-5 illustrates an effective way to show the portions of the total that each of the components represents. Note that in pie

charts, the largest portion usually “starts” at the 12-o’clock position, with sucessively smaller portions following as one moves in a clockwise direction.

Table B-2. Cost of project development

<u>Category</u>	<u>Development Cost (\$M)</u>
Drafting	58.2
Analysis	15.2
Test	38.8
Prototyping	22.6
Tooling	79.5
Overhead	120.5

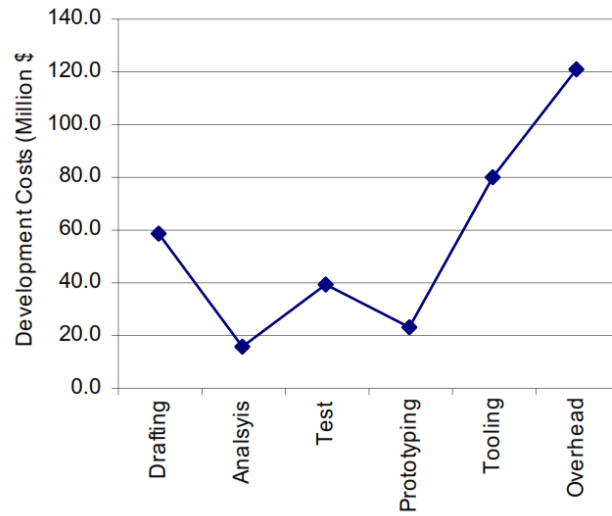


Figure B-3. Improper representation of data

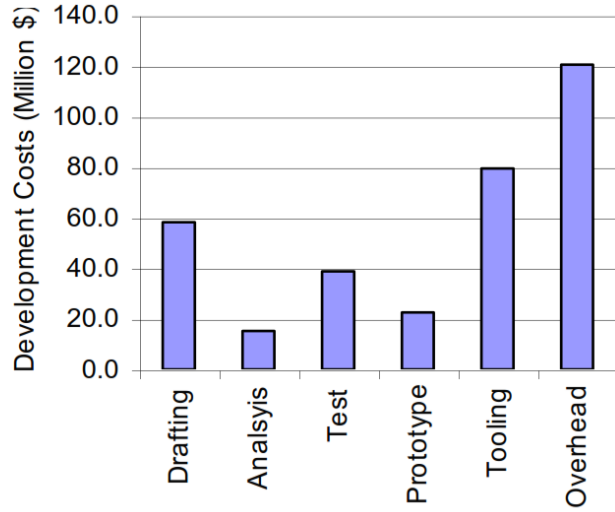


Figure B-4. Appropriate representation of the data

### Total Developments Costs

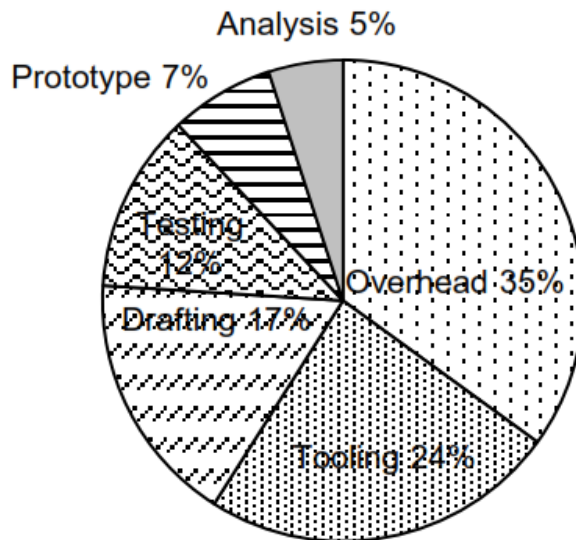


Figure B-5. Pie chart representation of the data

### Example 3

Figures B-6 and B-7 illustrate two ways of plotting the data from Table B-3. Both are xy scatter plots and the data points are plotted the same way. However, the lines in the first figure may not convey the trend that the author wished. The trend shown in the second figure shows a linear regression effectively representing the linear, not zig-zag trend.

Table B-3. Relationship of force and displacement

<u>Force (N)</u>	<u>Displacement (mm)</u>
0	0.0
10	6.0
20	8.9
30	16.1
40	21.0
50	24.2

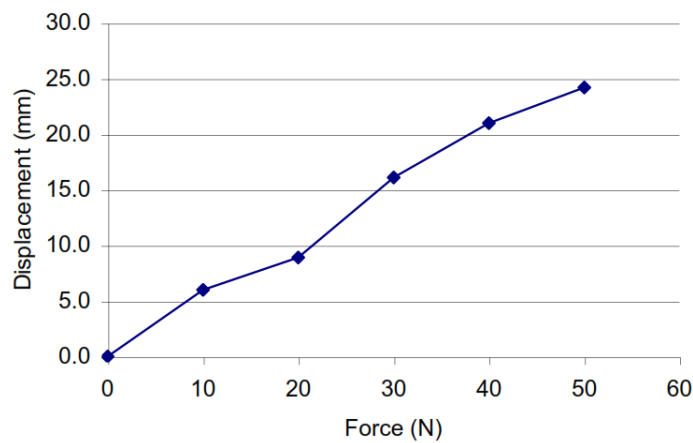


Figure B-7. Improper plot of data

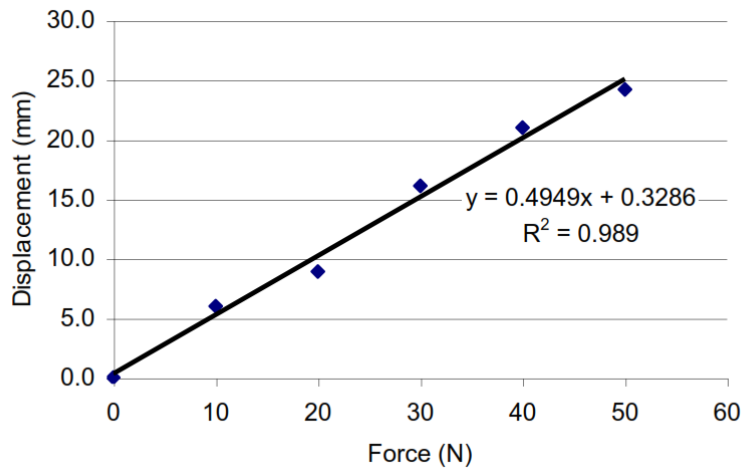
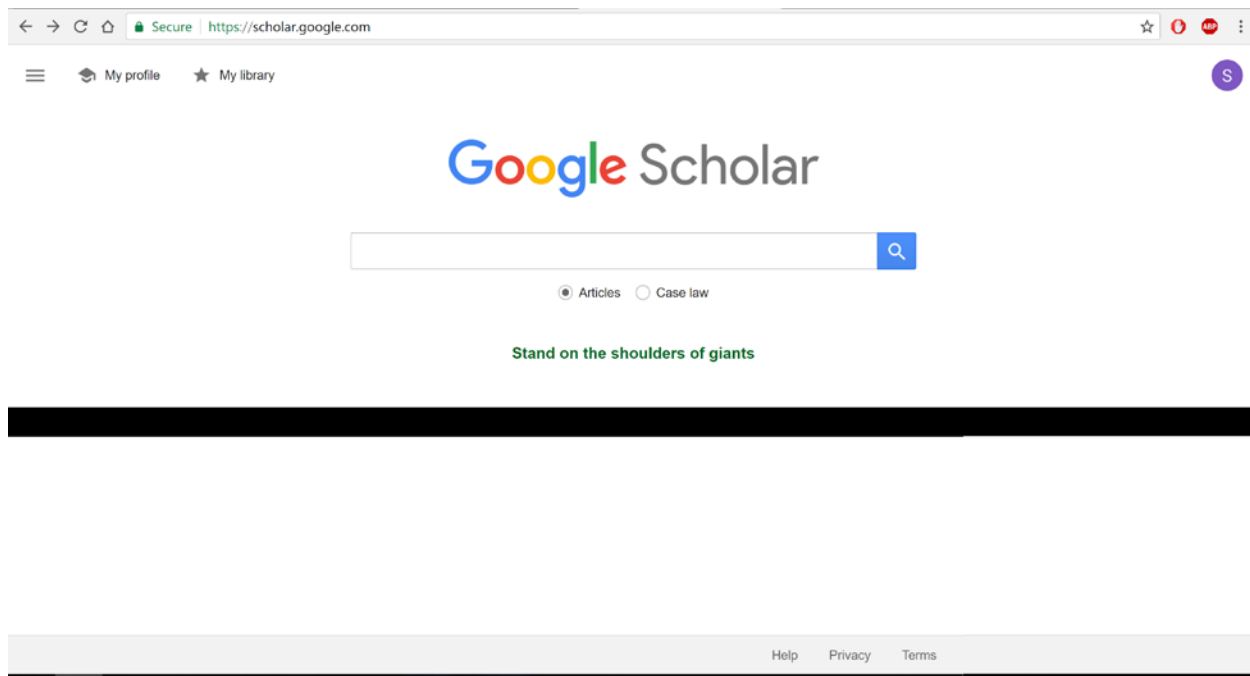


Figure B-8. Proper representation of data showing linear trend

## Unit Seven: Searching for references using google scholar

Google Scholar searches for scholarly material including books, journal articles, conference papers, chapters, and theses on a wide range of subjects. Results are sorted by relevance, based on full-text matching, where it was published, who wrote it, and how often it has been cited.

Google scholar (<https://scholar.google.com/>)



**Default search settings include:**

**Not case sensitive:** capital letters of search terms are ignored

**AND:** search terms are automatically combined using AND

**Keyword:** searches the fulltext of scholarly material, including citation and abstract

**Advanced search**

Advanced search ×

**Find articles**

with **all** of the words

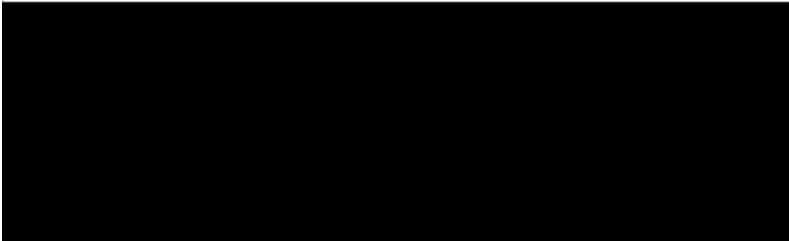
with the **exact phrase**

with **at least one** of the words

**without** the words

where my words occur  anywhere in the article  
 in the title of the article

Return articles **authored by**



## Unit Eight

### Oral Communication



Your audience only has one chance to hear your talk; they can't "re-read" your words if they get confused. Focus on being clear, particularly if the audience can't ask questions during the talk.

### **Think about your audience**

Yes, you want to demonstrate to your professor that you have conducted a good study. But professors often ask students to give an oral presentation to practice the art of communicating and to learn to speak clearly and audibly about yourself and your research. Questions to think about include: What background knowledge do they have about my topic? Does the audience have any particular interests? How am I going to involve them in my presentation?

### **Create effective notes**

If you don't have notes to refer to as you speak, you run the risk of forgetting to highlight something important and having no notes to refer to increases the chance you'll lose your train of thought and begin relying on reading from the presentation slides. Think about the best ways to create notes that can be easily referred to as you speak. This is important because nothing is more distracting to an audience than the speaker fumbling around with his or her notes. It gives the impression of being disorganized and unprepared. A good general strategy is to have a page of notes for each slide so that the act of referring to a new page helps remind you to move to a new slide.

Strategies for creating effective notes include the following:

- Choose a large, readable font [at least **14 point in Arial**]; avoid using fancy text fonts or cursive text.

- Use bolding, different-colored text, or a highlighter to mark elements of your speech that you want to emphasize. Don't over do it, though. Only highlight the most important elements of your presentation.
- Leave adequate space on your notes to jot down additional thoughts or observations before and during your presentation. This is also helpful when writing down your thoughts in response to a question or to remember a multi-part question [remember to have a pen with you when you give your presentation].
- Place a cue in the text of your notes to indicate when to move to the next slide, to click on a link, or to take some other action. If appropriate, include a cue in your notes if there is a point during your presentation when you want the audience to refer to a handout.
- Spell out challenging words phonetically and practice saying them ahead of time. This is particularly important for accurately pronouncing people's names, technical or scientific terminology, or words in a foreign language.

First of all, think about what you want to achieve and think about how are you going to involve your audience in the presentation.

Then...

1. **Brainstorm** your topic and write a rough outline. Don't get carried away—remember you have a limited amount of time for your presentation.
2. **Organize** your material and draft what you want to say [see below].
3. **Summarize** your draft into key points to write on overhead slides and/or notecards.
4. **Prepare** your visual aids.
5. **Rehearse** your presentation and practice getting the presentation completed within the time given. Ask a friend to listen and time you.

## GENERAL OUTLINE

### I. Introduction [may be written last]

- **Capture your listeners' attention.** Begin with a question, an amusing story, a startling comment, or anything that will engage your audience and make them think.
- **State your purpose.** For example, "I'm going to talk about..."; "This morning I want to explain...."
- **Present an outline of your talk.** For example, "I will concentrate on the following points: First of all...Then...This will lead to...And finally..."

### II. The Body

- **Present your main points one by one in a logical order.**
- **Pause at the end of each point.** Give people time to take notes, or time to think about what you are saying.
- **Make it clear when you move to another point.** For example, "The next point is that..."; "Of course, we must not forget that..."; "However, it's important to realize that..."
- **Use clear examples to illustrate your points and/or key findings.**
- **If appropriate, consider using visual aids to make your presentation more interesting** [e.g., a map, chart, picture, etc.].

### III. The Conclusion

- **Leave your audience with a clear summary of everything that you have covered.**
- **Don't let the talk just fizzle out.** Make it obvious that you have reached the end of the presentation.

- **Summarize the main points again.** For example, use phrases like: "So, in conclusion..."; "To recap the main issues...," "In summary, it is important to realize...."
- **Restate the purpose of your talk, and say that you have achieved your aim:** "My intention was ..., and it should now be clear that...."
- **Thank the audience, and invite questions:** "Thank you. Are there any questions?"