

Unit II

Basic Principles and Techniques in Scientific Writing

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Introduction

This part of your lesson will not be an uncommon learning experience because you have been exposed to different patterns of paragraph development in your expository writing courses. In this module, however, you will focus on the five writing techniques of special importance to technical people:

1. definition
2. classification
3. description of a process
description of a mechanism
4. comparison and contrast
5. interpretation

Though each technique will be discussed separately, you must bear in mind that in writing your reports, several of them will appear. The combination results in an intermingling of different techniques for an effective delivery of your message to your target readers.

This module hopes to provide you with practical guidelines in your scientific writing.

Objectives:

At the end of this module, you are expected to

1. differentiate the five writing techniques; and
2. identify the appropriate arrangement of information that would best communicate ideas to the readers.

DEFINITION

When you want to clarify or specify a certain meaning of unfamiliar terms or common terms used in a special way, or to discuss significant terms to be used on a longer work, use definition.

There are two types of definition, the formal and the informal.

- Informal definition consists of two or more synonymous expressions, substituted for the unfamiliar term. Example: Eosin, a beautiful red dye, is the potassium salt of tetrabromofluorescein used in making red painting ink.
- Formal definition consists of three parts: term, genus and differentia. Term is the word to be defined, genus is the group or class under which the term belongs and differentia states the distinctive characteristics of the term. Here's an example.

Term = *genus* + *differentia*

Space probe is a robot machine sent from Earth to explore other worlds in space.

In formulating a formal definition, you observe the following rules:

1. Use simple words.
2. If the term being used is a noun, the word after is should also be a noun.
3. Avoid using the term itself or any of its derivatives.
4. Do not put the term in too broad or too narrow a class.

Now try to examine the sentences in the following exercise.

QUESTIONS-1

Identify which rule of definition is not properly observed in the given sentences.

1. A network is anything reticulated or decussated, at equal distances, with interstices between the intersections.
2. A parallelogram is a quadrilateral with parallel sides.
3. A crystal is something that glitters in the sun.
4. A crystal is a formation of quartz geometrically patterned.
5. Soldering is when metal surfaces are joined by using metal or metal alloy.

However, there are serious definitions requiring amplification, extension or expansion. In this case, you achieve extensive explanation using details, examples, comparison, contrast, analogy, analysis and cause and effect. You do this when a one-sentence formal definition is inadequate to make your reader understand the difficult term. Let us look at this example.

An Amplified Definition

A space probe is a robot machine sent from Earth to explore other worlds in space. Probes can take close-up pictures of planets and moons, and even land on their surfaces. They can check sites for future visits by astronauts.

The probe is powered by solar cells that turn sunlight into electricity, but probes that will travel far away from the Sun carry small nuclear power plants instead. All information collected by the probe is turned into radio signals and sent back to Earth by way of an antenna, usually in the form of a dish. NASA has three stations around the world and each station has a 26-meter and 64-meter diameter dish. The antennas can detect signals as weak as one hundredth of one million million millionth of watt, enough to keep track of a space probe at the far edge of the solar system. The signal from such distant space probes is so weak

that even if it were collected for 40 million years, it would light a Christmas tree light bulb for only a thousandth of a second.

Did you notice how the amplified definition gives more details to clarify the meaning of a space probe? You can do this to help your reader understand better.

ANSWERS-1

The following rules of definition were not properly observed in the sentences given earlier.

1. Use of simple words
2. Use of the term itself
3. Too broad class
4. Too narrow class
5. Definition using is when, is what, is where



Remember that the placement of definitions in your report depends upon their importance to the text and the knowledge of the readers. Strategically, definitions may be placed in the text itself, in the footnote, in a special section in the introduction, or in the glossary at the end of the report.

CLASSIFICATION

When you divide items into groups, classes and categories, you are classifying those items. Classification is your technique to arrange any collection of objects, concepts or process into groups to make clear their similarities and differences. Through this method, separate details are grouped into classes, so that they can be visualized as a whole. The grouping is normally made according to a criterion or several criteria, standards or principles on which judgments are based.

Consider the following excerpts from “Understanding Nuclear Medicine” as it presents some common types of nuclear scans.

● ----- ●
Nuclear medicine procedures, commonly called “scans” provide information about both the anatomy of the body and the functions of its organs.

There are many kinds of nuclear medicine tests available. The following are some types of nuclear scans.

BONE SCAN

This test is special in that all the bones in the body can be evaluated with only one injection. The compound, injected into a vein, travels through the blood to the skeletal system. The scan is performed in a few hours (approximately 2 hours) after the injection and takes 30-40 minutes.

LUNG SCAN

The most common types of lung scans are used to show blood flow and the movement of air both into and out of the lungs. These tests are used to see if there are any blood clots in the lungs. It takes about 15-30 minutes to perform this procedure.

HEART SCAN

There are several types of heart scans which show different aspects of heart function and structure. With all of the heart scans the injection is given through the vein. The kind of scan the patient may undergo is determined by what specific information the doctor is seeking. The common types of heart scans are the blood flow scan, heart function test and heart muscle damage test.

THYROID SCAN

This determines the overall function of the thyroid gland. This test is not performed with a camera or scanner, but with a probe placed in front of the neck. This device measures the amount of activity in the thyroid gland.

There are many other nuclear medicine scans that are performed routinely. These include gallium scans to evaluate infection and certain types of tumors. Kidney scans to evaluate infection or obstruction, brain scans and scrotal scans among others.

Nuclear medicine procedures provide a safe, effective and painless means of gathering information that otherwise may be unavailable or require more risky diagnostic procedures.

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Note how the classification helps a layman to visualize the distinctive grouping of nuclear scans.

QUESTION-2

What principles should guide a writer when he decides to use classification?

ANSWERS-2

The writer should consider the following principles of classification:

1. Clarify what is being classified.
2. Use significant, useful basis of classification.
3. Make sure there is no overlapping of classification.
4. Name all species according to a given basis.
5. Help reader to understand the distinction between species.



DESCRIPTION OF A PROCESS

When you present a series of steps to get something done, use the description of a process. You do this to deliver an overall view of the method, so the reader can perceive the interrelationships of the various stages to one another and the process as a whole.

A report that explains process needs a structure that leads to descriptions that are clear, specific, accurate, and easy to understand. Generally, you have the following parts:

1. an introduction;
2. enumeration of steps in chronological order and an explanation of each step; and
3. an emphatic conclusion

The description of the action presents everything the reader needs to know to understand and even visualize the process. In some cases, the use of visual aids effectively shows the steps in an extensive process.

Style is another important consideration to look into.

- Active voice-Indicative mood—This gives the reader the greatest possible assistance in visualizing the action, but it is likely to become monotonous due to repetition of the action/doer.
- Passive voice-Indicative mood—There is no problem in handling the hypothetical operator, but the positiveness and aid to visualization is missing.
- Active voice-Imperative mood—This is a concise, easy to write, and reasonably satisfactory guide for immediate action; however, it is not really a description at all but a mere set of directions.

Now, see how the above-mentioned styles differ in their treatment of a process description. Take note also of the different parts of the report.

●-----●

Tissue Culture

1 *Test-tube cloning is a new kind of botanical alchemy to create new plant varieties. This is a plant tissue culture which facilitates genetic engineering in plants. Scientists have demonstrated that new plants can be regenerated using the somatic (body or non-reproductive) cells of mature plants.* **1**

There are six basic steps in tissue culture:

S T E P	Active voice- Indicative mood	Passive voice- Indicative mood	Active voice- Imperative mood
1	<i>The researcher cultures small roots and stems from the parent or matured</i>	<i>Small roots and stems from the parent or matured plants are cultured in nutrient</i>	<i>Culture small roots and stems from the parent or matured plants in nutrient</i>

	<i>plants in nutrient medium.</i>	<i>medium.</i>	<i>medium.</i>
2	<i>He observes the division and formation of undifferentiated calluses of cultured cells.</i>	<i>The division and formation of undifferentiated calluses of cultured cells are observed.</i>	<i>Observe the cultured cells divide and form undifferentiated calluses.</i>
3	<i>He monitors the growth of embryoids, calluses containing shoots and roots with fully differentiated cells.</i>	<i>Growth of embryoids, calluses containing shoots and roots with fully differentiated cells, is monitored.</i>	<i>Monitor the growth of embryoids.</i>
4	<i>He closely watches the growth of test-tube plantlets.</i>	<i>Growth of test-tube plantlets is closely watched.</i>	<i>Wait for the growth of test-tube plantlets.</i>
5	<i>He grows the plantlets in an agar medium and then he transfers them to the pail to continue their growth.</i>	<i>Plantlets are grown in an agar medium for a while and then they are transferred to the pail to continue their growth.</i>	<i>Grow plantlets in an agar medium for a while. Transfer to the pail to continue their growth.</i>
6	<i>He divides the calluses into fragments to clone plants into thousands of copies.</i>	<i>The calluses are divided into fragments to clone plants into thousands of copies.</i>	<i>Divide the calluses into fragments to clone the plants into thousands of copies.</i>

3 For the improvement of crops, orchard and ornamental plants, botanists have used various methods of propagating plants by vegetative reproduction. Tissue culture is a method that offers a lot of promise to clone plants. 3

However, you are more likely to be called on for an answer to this question, “How does the process work?” As such, you are expected to describe the process and not to focus on the human being performing the process or to enumerate plain steps to follow.

Here is another set of examples for your scrutiny. Examine the style, particularly the emphasis and manner of presentation.

Collection and Propagation of Seeds for Reforestation

The Philippines, being an archipelago, needs approximately 54% forest cover to maintain balance of nature. According to DENR, only 18% is forested 1999. The country has a long way to go. Some schools have entered into an agreement with DENR to reforest denuded forest lands.

Not all schools have the capability to do this, but this is not a hindrance. Others can provide seeds or seedlings for reforestation.

Here are the practical steps that schools in the country may adopt:

Version 1 (Passive-Indicative)	Version 2 (Active-Indicative)
<i>Trees whose fruits are in season are given attention (mahogany, gmelina, tamarind, acacia) because the dispersed seeds are usually found under the mother trees. The seeds are collected, placed in plastic bags, and kept in a dry place. Meanwhile, used plastic cups, preferably 12 ounce or bigger, are collected to provide enough space for seed germination. The cups are filled $\frac{3}{4}$ full of soil. Each cup is planted with one seed and slightly covered with soil. The plants are stored in a designated place where indirect sunlight is received. They are watered everyday and allowed to grow 3 inches before they are transferred to black bags where they can grow up to a foot in height. This height is required to increase their survival rate, once they are transplanted in the reforestation area.</i>	<i>The schools give attention to trees whose fruits are in season like the mahogany, gmelina, tamarind and acacia because the dispersed seeds usually scatter under the mother trees. They collect the seeds, place them in plastic bags and keep them in a dry place. Meanwhile, everyone collects used plastic cups, preferably 12 ounce or bigger, to provide enough space for seed germination. The workers fill the cups $\frac{3}{4}$ full of soil, plant each cup with one seed and cover the seed lightly with soil. They store them in a designated place where they receive indirect sunlight. The plants get enough water everyday. The watchers wait for the seedlings to reach 3 inches before they transfer them to black bags where they can grow up to a foot. This height ensures high survival rate when the time comes to transplant them in the reforestation area.</i>

Some seedlings can be transplanted in the school grounds, but the others can be donated to reforestation projects outside of the school. Different schools in

the community could also work together to produce enough volume of seedlings needed in reforestation.

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Why don't you try to answer the following questions?

QUESTIONS-3

1. Differentiate the use of the three styles in writing a process description in terms of (a) emphasis and (b) presentation.
2. Which is the best style to adopt?

ANSWERS-3

1. Active-Indicative emphasizes both the action and the operator to perform the process.
Passive-Indicative never repeats the hypothetical operator and lessens the emphasis on the action.
Active-Imperative suggests that the reader is the operator to perform the given directions.
2. The presentation of process description commonly utilizes the active-indicative and passive-indicative or sometimes a combination of the two, but not the active-imperative.

DESCRIPTION OF A MECHANISM

When you describe a mechanism, your treatment of the subject depends upon what the reader needs to know. If the reader wants to construct his own device, you must give a detailed description. However, if he is after its function, you give a general description of the gadget.

The most logical way of organizing your description is to start with an introduction covering what the machine is, its function, its physical appearance or nature, and the principle governing its operation. Then, move to part-by-part description to discuss the various component parts which make up the machine. Lastly, conclude with a fitting general description of the mechanism in operation. Reinforcing the textual operation with pictures and/or illustrations showing the physical appearance of the mechanism will make the description more concrete.

Based on a simple outline, observe how a logical organization of ideas is attained in the following description of a mechanism.

- I. Introduction
 - A. What the mechanism is
 - B. Purpose
 - C. General appearance
 - D. Division into principal parts
- II. Part-by-part description
- III. Brief description of the mechanism in operation

How a Camera Works

The important pieces of photographic equipment are the camera and the film, for without these two, there would be no photographs. There are many kinds of cameras, but all of them can be used to take good photographs. No matter how simple or how complex a camera is, it has five basic parts: the body, lens, shutter, film holder and viewfinder.

The body of a camera is a lightproof framework or box. It keeps out all light except the light that passes through the lens.

The lens is a piece of glass or plastic with curved surfaces. The lens concentrates the light rays as they enter the camera to make a sharp image of the photographed object on the film.

The shutter is a mechanical device behind the lens. It opens and closes to let the light in.

The film holder keeps the film flat, so that the image can be accurately focused on the film. It is usually in the back of the camera.

A viewfinder is a part of all cameras. It shows the scene that the lens will focus on the film. Some viewfinders are glass windows. Some make use of lenses, and some are reflecting prisms that show the actual image coming through the lens.

The camera is loaded with film that should be placed neatly behind the lens. Using the viewfinder, one can locate the subject to be photographed. The viewfinder shows in advance what the picture will be, and once satisfied with what one sees in it, he holds the camera steady, and presses the shutter release. When the shutter clicks, it means the film has been exposed. He advances the film so that the next frame is in position behind the lens. He is now ready to take his next picture. Once the roll of film is used up, he can develop and print his pictures.

Remember that no matter how simple or complex a mechanism you want to describe to your reader, you will succeed if you observe a systematic presentation. The decision to use an illustration is a matter of adaptation to your reader's need.

QUESTION-4

How does an illustration facilitate a description of a mechanism?

ANSWERS-4

1. A graphic form of presentation usually amplifies the verbal form to aid comprehension
2. A drawing can effectively relate to a written discussion.

COMPARISON AND CONTRAST

When you want to point out similarities and differences using a set of criteria or items as basis, you use comparison and contrast. Not only will your piece of writing make the unfamiliar familiar, but it will also make a critical appraisal of the subject; thus, aiding your readers to comprehend better as they concentrate looking for similarities and difficulties.

There are two ways to organize similarities and/or differences.

1. The block pattern or opposing pattern presents the object or item being compared and/or contrasted one at a time.

For example, you want to compare two models of computer printers, you may have an outline like this one:

- | | | | |
|----|---------------------|-----|---------------------|
| I. | Printer X | II. | Printer Y |
| | A. Print Method | | A. Print Method |
| | B. Print Head | | B. Print Head |
| | C. Print Speed | | C. Print Speed |
| | D. Character Format | | D. Character Format |
| | E. Character size | | E. Character size |
| | F. Dimension | | F. Dimension |

2. The alternating pattern moves from the first object to the second as it presents comparison or contrast point by point. Using the same topic on printers, your outline will look like this:

- | | | | |
|------|--------------|-----|------------------|
| I. | Print Method | IV. | Character Format |
| | A. Printer X | | A. Printer X |
| | B. Printer Y | | B. Printer Y |
| II. | Print Head | V. | Character Size |
| | A. Printer X | | A. Printer X |
| | B. Printer Y | | B. Printer Y |
| III. | Print Speed | VI. | Dimension |
| | A. Printer X | | A. Printer X |
| | B. Printer Y | | B. Printer Y |

Look at this table comparing two substances: diamond and graphite.

Diamond	Graphite
Composition: Element Carbon (C)	Composition: Element Carbon (C)
The hardest known naturally occurring substance	Soft and black with metallic luster
Non-conductor of electricity	Conductor of electricity
Transparent when pure with twice the refractive index of glass-making it a very	Low cost or easily available

valuable and costly gem	
Cannot withstand very high temperature	Can withstand far higher temperature than most metals and ceramics
Used in drill bits, cutting tools and abrasives	Used in making electrodes and crucibles, in the manufacture of paints

QUESTIONS-5

Try to write out sentences about each of the data provided under each substance.

Sentences about Diamond

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____

Sentences about Graphite

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____

Now, continue with the next exercise. Using the alternating pattern, rewrite the sentences in paragraph form using appropriate structure and transitional devices to show comparison/contrast. The first part is done for you.

Diamond and Graphite: What is the Difference?

What makes some substances made up of the same atoms different in properties and uses?

Graphite and diamond are both made up of carbon atoms that are found in charcoal, pencil or carbon paper. But they differ in properties and uses.

INTERPRETATION

When you are interested to establish a meaningful pattern of relationships among a group of facts, you use interpretation. There are three key points to remember if you decide to communicate to your readers what you have found out using your logical interpretation of facts.

1. the purpose of the interpretation in concise form, meaning without being lengthy or circuitous, it must present the basic and subordinate problem, define unfamiliar term, and provide background information
2. explanation about the obtained facts to deliver the clear possibilities, so the reader can view the information from a deeper, broader perspective
3. statement of the significance of the evidence and conclusion to wind up the discussion and give the reader a balanced view

Bear in mind that an interpretation is not a simple reporting of gathered facts but an informed, fair, and objective presentation of ideas, so the reader can see a pattern, a trend or a relationship of ideas which will lead him to better understanding

Try to observe if the above-mentioned requisites are satisfied in the example below.

●-----●

Energy-Efficient Products

Thousands of megawatts of electricity are generated everyday for the country's energy needs. However, the escalating prices necessitate the control of consumption to lower monthly electric bills. One measure that can greatly help is the use of energy-efficient products.

Energy-efficient products are electric equipment or devices that require much less electricity to operate. They typically offer the same or even greater function compared to similar products that use up more electricity.

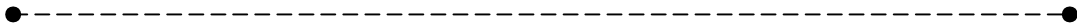
The best-known energy-efficient products are the compact fluorescent lamps or CFLs. These lamps consume up to 75 percent less energy than incandescent lamps and they last up to 10 times longer. A 32-watt CFL is also all it would take to produce the same illumination as a 100-watt bulb. The difference primarily lies in the way they produce light. While incandescent bulbs produce light by heating a filament to high temperatures, CFLs do the same by causing substances called phosphors to emit light. Their widespread use can lead to substantial energy savings because a big percentage of the electricity generated every day is used to light up homes and buildings.

A significant amount of electricity can also be conserved with the use of energy-efficient air conditioners. These air conditioners can be easily identified by their high energy efficiency ratio (EER). The EER is calculated by dividing the cooling capacity of an air conditioner with its power consumption. The cooling capacity quantifies the maximum amount of heat that the air conditioner can remove from an enclosed space. Its power consumption, on the other hand,

indicates how much electricity in watts is used up when the unit runs at its maximum cooling capacity. The figures for EER, cooling capacity and power consumption are all listed on the so-called energy label at the back of the unit. The general rule to ensure that the unit is energy efficient is this: for the same cooling capacity, the higher the EER, the more efficient is the unit and the lesser is its overall operating cost.

The information to look for in a refrigerator is the energy efficiency factor (EEF). The EEF is the ratio of the adjusted total storage volume in liters divided by energy consumption. The total storage volume is the combined capacity of the freezer and fresh food compartment while the energy consumption in kilowatt-hour is the amount of energy used by the unit on a 24-hour basis. The higher is the EEF, the more efficient is the unit and the lower is the resulting energy consumption.

Ensuring the efficient use of electricity does not only result in lowering electric bills but also helps to protect the environment. The more energy is saved, the lesser is the need for additional power plants, most of which release substances that pollute air and contribute to global warming. Clearly, energy-efficient products cut electric consumption and prevent environmental degradation.



QUESTION-6

What attitude of the writer must be adopted to aid his interpretation?

Summary

The basic principles and techniques in scientific writing of special importance to technical people were presented in this Module. The different techniques were: (1) Definition; (2) Classification; (3) Description—of a process, of a mechanism; (4) Comparison and contrast; and (5) Interpretation. The distinctive features of each were discussed and the appropriate organization of information was explained for the writer to deliver clear message to the reader.

Each technique was given exclusive discussion, but in actual writing of scientific reports, several techniques may work together to suit the needs of the reader and to fit the purpose of the writing task.

You will appreciate and learn more about these topics as you practice using them in your academic writing inside or outside your English 10 class. Happy writing!



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English 10 (Writing of Scientific Papers)

Exercise 2 Extended Definition of a Process

I. Using Definition

You may use formal or informal definition to clarify an idea.

- Step 1. Choose one subject for your topic sentence.
Step 2. Using the topic sentence as guide, complete the simple paragraph.

Subject-virus, amplifier, success, education, ATM card

Topic Sentence-The term _____ means different things to different people.

To most people, _____ means _____
_____ (informal definition)

To some, _____ means _____
_____ (informal definition)

To others, _____ means _____
_____ (informal definition)

Basically, _____
_____ (formal definition)

II. Extending Definition

You need not limit yourself to one pattern of development. You may use several in combination.

- Step 1. Choose a subject related to your course. Give a formal definition.
Step 2. Extend your definition using a combination of any of the five writing techniques.
Step 3. Include a simple illustration to complement your text.