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Developing a Task-based approach for Teaching Scientific and Technical Writing in English

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1 Introduction

Michael Faraday, the great British physicist and lucid expositor of his own work is reported to have defined research as consisting of three steps: start, finish, publish. (Rutherford Andrea J 2001:35).The growing demands and increasing expectations of the professional world make it necessary for scientists and technologists to communicate their ideas clearly and effectively in writing which may include the definition of scientific and technological terms, description of an equipment , process adopted in an industry, reports written for an accomplished project or proposals submitted to receive financial support for a research project. In the world of increasing international academic research articles, English as an international language of science and technology plays an important role and serves as the major channel of sharing scientific knowledge among the members of academic discourse community. (Chalak and Norouzi 2013) The challenge lies not only in achieving scientific and technical advances but also in meeting the demand for conveying involved concepts clearly and concisely; additional effort is required to present good ideas effectively. Scientists from all disciplines in their attempt to explain something to a third party may or may not become comprehensible to each other. It is not just enough to be understood; it is important to be not misunderstood.

Those who work in engineering and other technical fields too often view writing as an unpleasant- although necessary-task. This all-too-common dislike for writing may originate in part with past unpleasant experiences, perhaps when a teacher or reviewer returned an assignment covered with so much red ink that it appeared to be bleeding. Although the comments would have been well intentioned, the recipient might well have experienced a sense of failure and developed a range of problems including procrastination, anxiety, and writer's block. (Stevenson&Whitmore, 2002:03) Or perhaps the students of science and technology may find the writing classes dull and drab and hence may not develop a liking for the same despite knowing that acquiring proficiency in writing is vital for their professional success. Even many teachers realise that writing is a problem for their students because, most of the times, when involved in writing tasks with their students, teachers perceive a feeling of frustration and discontent which reminds them of their own problems with writing when they were at school.(Luchini

2010). Here comes the importance of task-based approach to teaching writing for such students.

Task-based approach as against conventional approach requires the teachers to use various tasks – such as listening, speaking, reading, identifying, analysing, and discussing to teach writing to the students of science and technology. As we are aware, in the conventional approach, teachers give a writing assignment to their students and ask them to complete the same in specified time. After the students complete it they evaluate and return the answer sheets incorporating their comments. This approach expects the students to take the entire burden on themselves and the teachers' role is insignificant. On the other hand, in the task-based approach, the students are made to engage themselves in some task in which the teacher acts as a facilitator. Through this task, the students are taught various aspects of writing and hence they find it interesting.

This paper provides an insight into the three important writing tasks the students of science and technology need to undertake during the course of their academic or research tenure: definition, description of equipment, description of a process. For each of these three categories of writing, two sample tasks have been discussed and answers have also been provided to facilitate the teachers of English for Science and technology (EST).

2 Tasks / Exercises related to Definitions, Descriptions and Processes

2.1 Technical Definitions

A theoretical explanation of the term "Definition"

Definitions of terms are the foundation of technical writing. A precise set of terms is used in technology, and only with a common understanding of those terms can information be communicated clearly. In its broadest sense, a definition is a statement giving the meaning of a word or term (Nagaraj 2003: 21). However, in EST, definitions are used a rhetorical devices to clarify the meaning of a term in a compact and straightforward manner.

Let's now look at a simple definition "A generator is a machine which converts mechanical energy into an electrical one"

Hyper Text Transfer Protocol is a computer access code that provides secure communications on the Internet, an intranet, or an extranet.

What is the term defined here? The term defined is generator. When we define, we give information the class (C) to which the term (T) belongs and how it differs (Differentia-D)

from other members of the class. Now let us examine the above definitions and find out the term, the class and the differentiating quality of the term.

Term = generator
Class = machine
Differential = converts mechanical energy into an electrical one.

Extended or Expanded Definitions

Sometimes it is difficult to define terms in a single sentence. It may have to be expanded. Definitions are expanded by using methods like comparison and contrast, analogy, example and derivation. Students may come across this type of expanded or extended examples in their subjects in science and technology. (Andrews and Bickle 1982: 136)

A diesel engine is similar in design to a conventional engine except that it is more heavily constructed to withstand extremely high compression. The high compression allows the diesel to operate on a much cheaper grade of fuel than the type of fuel used in a conventional engine

An ecosystem is similar to a computer or any other mechanical device that has many intricate and related parts. If even the smallest component breaks down, the machine will not function properly. So also the ecosystem is damaged by problems caused by humans.

In the first definition the diesel engine is compared with the conventional one and the diesel engine's distinguishing features are brought out. Here the method used is comparison and contrast.

In the second definition also there is comparison. But ecosystem is defined by using the analogy of a machine (like computers).

When you need to provide an extended definition of a paragraph or more, in addition to providing the term, type, and distinguishing characteristics, also consider including examples, procedures and descriptions. Look at the following definition of a voltmeter: (Gerson & Gerson 2000: 68)

The voltmeter is an instrument used to measure voltage. The voltmeter usually consists of a magnet, a moving coil, a resistor, and control springs. Types of voltmeter include the microvoltmeter, millivoltmeter, and kilovoltmeter, which measure voltages with a span of 1 billion to 1. By connecting between the points of a circuit, voltmeters measure potential difference.

Tasks to teach Definitions

Task 1

Here are some definitions. Identify its parts and fill in the grid given below. The first one is done for you:

1. Instruments of measuring temperatures are called thermometers
2. Chemistry may be defined as the branch of science which deals with the compositions and behaviour of substances
3. Torque is a force that tends to rotate or turn things
4. Electron is a sub-atomic particle carrying a negative charge
5. Girder is a main horizontal or rear horizontal structural member that supports vertical loads.
6. A car is a vehicle that contains four wheels and is driven on land

Term	Class	Differentia
Thermometer	Instrument	Measuring temperatures
Chemistry	-----	Composition and behaviour of substances
----	Force	Rotate or turn things
Electron	Sub-atomic particle	-----
Girder	-----	Supports buildings
Car	Vehicle	-----

Answers

Term	Class	Differentia
Thermometer	Instrument	Measuring temperatures
Chemistry	Science	Composition and behaviour of substances
Torque	Force	Rotate or turn things
Electron	Sub-atomic particle	Negative charge
Girder	Horizontal structure	Supports buildings
Car	Vehicle	Four wheels & driven on land

Task 2

The passage given below abounds in definitions. Pick out those definitions and write them down. While writing the definition follow the format discussed in the preceding discussion. You may have to remove unnecessary information

Light may be defined as the external physical agency by which the eye receives the sensation of sight. A body will be visible to the eye only when the light transmitted from it reaches the eye. Light itself, however, is invisible. A body like the sun, which emits light of its own accord is said to be self-luminous. A body which does not emit light, but is seen only by means of light which it receives from a luminous is said to be non-luminous. Most objects in this world are non-luminous. A substance through which light can pass is said to be transparent e.g. glass, water, etc. Substances which obstruct the passage of light through them are said to be opaque. Substance which allow the passage of light through them but through which objects cannot be seen are said to be translucent e.g. ground glass, oiled paper.

1.----------
2.----------
3.----------
4.----------
5.----------
6.----------

Answers

1. Light may be defined as the external physical agency by which the eye receives the sensation of sight.
2. A self-luminous body is a body which emits light of its own accord.
3. A non-luminous body is a body which does not by itself emit light
4. A transparent substance is a substance through which light can pass
5. Opaque substances are substances which obstruct the passage of light through them
6. Translucent substances are substances which allow the passage of light through them but through which objects cannot be seen

2.2 Technical Description

The line demarcating definitions and descriptions is blurred. An expanded definition is in fact a short description. Definitions limit the meaning of a term and are more focused. In fact, descriptions provide more information than definitions. According to Oxford University Dictionary (seventh edition) 'description' is "a spoken or written representation of a person, object or event. According to Gerson & Gerson (2000: 257), a technical description is "a part-by-part description of the components of a mechanism,

tool or piece of equipment." When we describe, we generally state the size, shape and/ or colour of things / persons we describe. In EST, the watchwords are clarity, precision and objectivity. Hence, while describing the shape, size, colour, as well as dimension, weight, material volume or texture of an object, we have to take great care in choosing the words which will carry clear and precise meaning. Apart from the descriptions of these physical characteristics, functions and uses of the object as well as its components are also an important aspect of description in scientific writing.

Technical descriptions are important features in several types of correspondence. They provide the end user with information about the mechanism's features or capabilities. For example, this information may tell the user what are the various components of this mechanism, quality and function of these components.

2.2.1 Types of Technical Description

Physical descriptions: Physical descriptions range from general to specific. In general description, physical characteristics are described using general spatial terms such as below, near, at the centre, opposite, etc. In specific description, understandably more specific spatial terms like 1 mm. long, 0.25 cm thick, at an angle of 20 degrees, etc., are used.

The following questions may enable you to decide how to give the general or specific descriptions:

- Is the specification vital to the description of the object?
- What is the level to which it is pitched? For instance, is it meant for general readers or for specialists; is it for school students or for post graduates?
- Where is the paragraph placed? If it is an introductory paragraph, general terms are used and later a more detailed description using specific terms are given in subsequent paragraphs.
- What is the nature of the subject? In most of the descriptions in physical sciences, great precision and accuracy is demanded. Hence the description has to be specific. In other sciences, rigorous specifications may not be necessary.

Example

Megamouth Shark

The appearance of Megamouth is distinctive.It is a large mouth with small teeth, a broad rounded snout, a generally brownish-blackish colour on top and white underneath, and an asymmetrical tail with a long upper lobe. The interior of its gill slits are linked with finger-like gill rakers that capture its food. A relatively poor swimmer, the megamouth has a soft, flabby body and lacks keels. These are very large sharks, with the largest

specimen to date reaching 4.8 meter (16 feet) and 1 tonne (2205 lb). (Source: Wikipedia)

Functional Descriptions

Functional descriptions generally accompany the physical descriptions. Many of the definitions in scientific writings emphasize on the functions. Take for example the definition of generator: "A generator is a machine which converts mechanical energy into electrical energy." The function of the generator is included here.

Descriptions typically include a definition of the object or idea, an orientation to the overall characteristics, followed by detailed descriptions of the parts in a logical order. (Houp 2002:107) For example, to describe a device, a writer would first describe the function of the device (what it does and when it is needed). Next, the writer would describe the physical appearance of the object and its component parts, one by one, in the order in which they appear or play into the larger function of the device itself.

Akin to various other types of technical writing, the descriptions do include a title precisely stating the topic of the description. This could be the name of the mechanism, tool, or piece of equipment being described.

Example

Sniper Rifle

The sniper-rifle is a self-loading weapon. The reloading of the rifle is based on utilizing the energy of powder gases which are channeled from the barrel bore to the gas piston. Upon firing, a certain amount of the powder gases following the bullet flows through the port in the barrel bore wall into the gas chamber, exerts pressure upon the front wall of the gas piston and throws back the piston with pusher and, consequently, the bolt support into the rearward position.

Task 1

Understanding the role of nouns and adjectives in technical descriptions

The following description is taken from the instructional manual for a Fluke digital multimeter, model 8010A/8012A. Write down the physical details, nouns and adjectives describing colour, texture, size, quantity and shape.

The Fluke digital multimeter is light (2 pounds and 6 ounces for the standard model) with a low profile that hugs the work bench. The light gray case goes with any décor and is made of rugged, high-impact plastic. The handle can be rotated to eight positions to function as a handle for carrying the instrument or as a stand to tilt the front panel up for convenient operation. The handle can be rotated out of the way. To change the handle position, pull out on the round hubs where the handle joins the meter; then rotate the handle to the desired position. On the rear of the meter are a Phillips screw and a power cord receptacle. The Phillips screw holds the outer cover in place.

The LCD (liquid crystal display) covers the left part of the front panel. The right-hand portion of the front panel contains two horizontal rows of controls and connectors. The top row consists of ten pushbuttons-the four switches on the left determine the measurement function of your multimeter and the other six switches determine the range of measurement. The bottom row consists of controls and the input terminals.

Classroom discussion

Once the students are ready with the answers, teachers can ask them to read out the list of nouns and adjectives. Then they can ask the students to elaborate on what these nouns and adjectives describe. For instance, if the students have marked *light* (line 1) as a noun, they are wrong because, the word *light* here has been used as an adjective that describes the weight of the object. On the other hand, the same word *light* in line 2 has been used as an adjective that describes the colour. Similarly, the other adjectives (rugged, high-impact, front, round, power cord, outer) and nouns (multimeter, work bench, décor, plastic, handle, instrument, stand, panel, hubs, screw, receptacle, cover) can be discussed enabling the students understand not only the role of nouns and adjectives in describing an object but also the difference between their usage.

Task 2

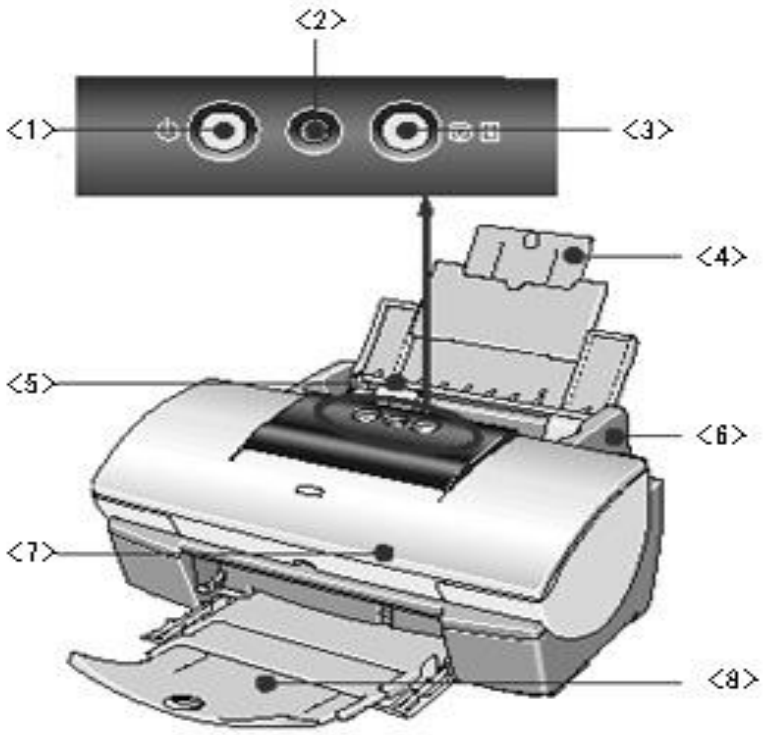
Describing a technical device

The teacher shows the diagram of a computer-printer and poses few questions to the class. Students who have an idea about the device would come out with the names of the parts and their function. Then she asks the students to work in teams and write down the functions of various parts of a printer. They also need to describe how the printer works. Once the students complete the task, the teacher asks the teams to read out the description. Finally she distributes the printed version of the technical description of a printer to the teams and asks them to compare it with their versions.

Questions

Look at this diagram and identify the device.
Have you ever used such printers?

Can you name the numbered parts?
Do you know how the printer works?



(Source: Google image of *Parts of a Printer*)

Answers (Parts and Functions) :
1. Power Button: Press to turn the printer on or off.
2. Power Lamp: Indicates that the power is on/off and conditions of errors.
3. RESUME/CANCEL Button: Press when an error occurs to cancel printing in progress, or to perform print head cleaning.
4. Paper Rest: Supports loaded paper.
5. Paper Guide: Pinch and slide to align to the left edge of the paper.
6. Sheet Feeder: Load paper here. Multiple sheets of paper can be loaded (except for some particular types of paper).
7. Front Cover: Open to replace the ink tanks or to remove jammed paper.
8. Paper Output Tray: Printed paper is ejected here.

Teachers can discuss the description of any other technical device such as nuclear reactors, mobile phones, aircrafts, etc. The tasks described above can also be effectively used to teach certain aspects of language such as vocabulary, spelling, use of numerals in technical writing, appropriate use of tense and correct forms of verbs, etc.

2.3 Technical Process

Process and procedures are concerned with development and change and hence consist of series of steps. Process description can be written to explain about human tasks such as how television set is assembled. It can also be used to explain tasks that are beyond human tasks such as how the solar system was formed. The technical description of a process describes how something works, beginning with general information about the overall function of the process, and proceeding to the specific materials or skills required. The description can include a flowchart or schematic to show the sequence of actions or decision points in the process.

Task 1

The teacher explains the three parts to be included in writing the technical description of a process: (i) Introduction to the device involved in the process (ii) steps in the process (iii) conclusion of the process and divides the class into teams of 5 students. Each team is given the text and is asked to read the passage carefully. Then the teams are asked to focus on the second paragraph and write down the steps in ten lines:

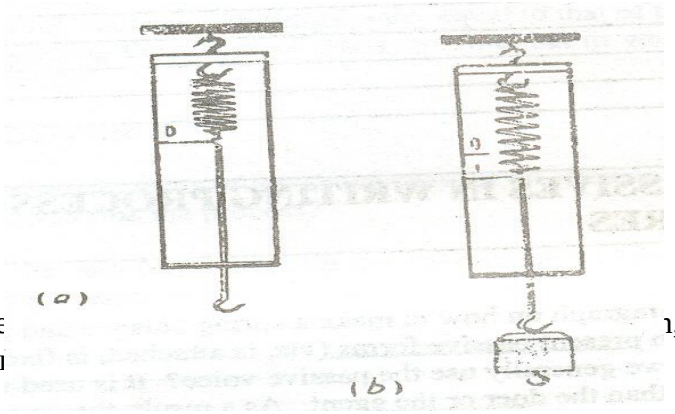
Text
Step-by-step process of how a spring balance is made

The device used to measure forces is called a spring balance or a dynamometer. The design of a spring balance is based on the fact that the elastic force of a spring increases as many times as the deformation of the spring.

Here is how the simplest spring balance is made. A spring with a rod and a hook at the end is attached to a plank covered with white paper (Fig. a.). A pointer is fixed at the upper part of the rod. The indication of the pointer is marked on the paper when the spring is not stretched, this is a zero scale. Then a weight with a mass of 1/9.8 kg., i.e. 102 g. is suspended from the hook. A force of gravity of 1 N acts upon the weight. The force of 1 n stretches the spring and the pointer goes downwards. Its new position is marked on the paper with the digit 1 (Fig. B.). Next a weight with a mass of 204 g is suspended and the new indication is marked with the figure 2, which means that in this case the elastic force of the spring is equal to 2 N. Using the weight of 306 g. a mark of 3 N is made and so on.

We can mark scale divisions corresponding to the tenths of a Newton: 0.1:0.2; 0.3 N, etc. For that purpose, we must divide the distances between the mark 0 and 1; 1 and 2;2 and 3, etc., into 10 equal parts.

The graduated spring is the simplest spring balance (to graduate a device means to calibrate it with a scale).



Teachers ne ı, use of cohesive devices such as coni

Task 2

This task is used to make the students understand the importance of flow charts in describing a technical process. It can also be used to check and enrich the vocabulary skills of students.

Teachers divide the class into teams of 5 and give them a passage to read. They can also read out the passage or use videos if available. They can also use power point slides to show the passage and ask the students to read and take notes. Once the students are ready, teachers can distribute the flow chart with some blanks and ask the teams to fill in the blanks. The answers can be discussed. Teachers can also show some vocabulary / grammar exercises (Ex. A, B and C that follow the flow chart) on the power point slides and can ask the students to come out with answers.

Passage

Extraction of gold

Scan the following passage quickly to identify the types of mining and the ways of obtaining pure gold.

The method of mining gold varies with the nature of the deposit. Two types of deposit can be considered here : one is placer deposit, which refers to the occurrence of gold in particles in the sand or gravel in the bed of a river; the other is lode mine which refers to gold occurring in veins in gravel or rock. In placer mining, the separation of gold from gravel or other impurities is done by sifting. Hand pinning is also common, in which water and gold-containing gravel are swirled in a pan. Gold, being heavy, settles down, and the gravel is washed away. In lode mining, shafts are dug into the rock following the

veins of gold. Using explosives, the rock is broken and the ore is obtained. The ore is then transported to mills.

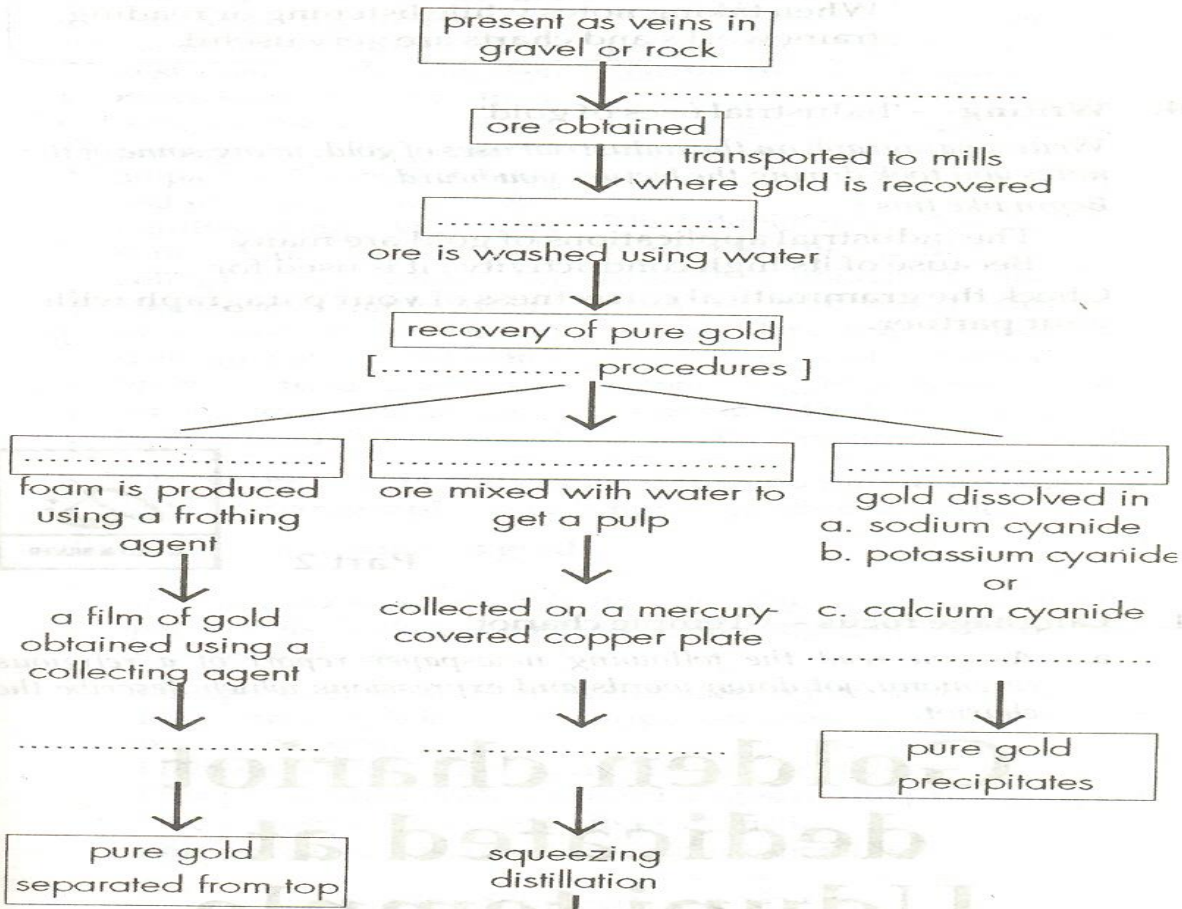
In milling, the ore is first crushed using heavy machines. This is followed by sluicing, that is, using water to wash the ore into sluices or artificial water-channels in which there are grooves which trap the gold.

There are three ways in which this gold is treated to obtain pure gold. They are floatation, amalgamation and cyanidation. In the first method, a frothing agent is added to produce foam. A collecting agent is used to produce a film on the gold, which then sticks to the air bubbles. Gold is then separated from the top. In amalgamation, the ore, mixed with water to form a pulp, is collected on a copper plate covered with mercury. The mercury is then removed, partly by squeezing it out and partly by distillation. The cyanide process is now widely used. In this process, a weak solution of sodium, potassium or calcium cyanide is used to dissolve the gold. The gold is then precipitated by the addition of zinc crust.

The gold thus obtained is melted and cast into bars.
(source : English for Engineers and Technologists, 1990)

Now discuss the passage with your team-mates and complete the following flow-chart:

Extraction of Gold



Exercise **1**

Exercise (A)

Here is a paragraph describing gold. Put in adjectives from the list below to fill the gaps in the paragraph. The words and phrases should help you.

precious expensive indestructible prevalent unique exquisite exceptional excellent criminal

Gold is _____ among metals since it possesses certain properties *not found in any other metal*. It is a rare metal with a beautiful yellow colour. It is not affected even by strong acids. The *only liquid which can dissolve gold* is a mixture of hydrochloric acid and nitric acid; one can, therefore, say that gold is nearly _____. It has certain _____ qualities which make it an _____substance for jewellery. Skilled goldsmiths can make gold ornaments of _____ Workmanship. Gold jewellery is _____and people often show off *their wealth* by wearing ornaments of gold. Some people collect gold for its own sake. Gold, being a _____metal, inspires man's greed. It gives rise to _____acts *like theft, robbery and even murder*. Another crime that is _____in India is the smuggling of gold into the country.

Answers: unique, indestructible, exceptional, excellent, exquisite, expensive, precious, criminal, prevalent

Exercise B

Some nouns are formed by adding suffixes to adjectives or verbs. Some of the common endings used to form nouns are –ity, -cy and –ce.Add the appropriate endings to the following adjectives to make nouns.

rare, impure, indestructible, ductile, important, reliable, malleable, abnormal frequent

Answers: rarity, impurity, indestructibility, ductility, importance, reliability, malleability, abnormality, frequency

Exercise C

You must be familiar with the words in column A by now.
Match the words in Column A with their meanings in column B.

Column A	**Column B**
i.Extraction	a. Group
ii.Convoy	b.Bringing together
iii.Flotation	c.Suffering
iv.Salvage	d.Process of treating something with cyanide compound
v.Stagnant	e.Remaining on the surface
vi.Amalgamation	f.Taking out
vii.Distress	g.Rescue
viii.Cyanidation	h.Not moving or changing

Answers: (i) f (ii) a (iii) e (iv) g (v) h (vi) b (vii) c (viii) d

Conclusions

As enumerated through three important aspects of science and technology namely definitions, descriptions and processes, writing skills are vital for students of science and technology. In order to make the writing process more interesting and simpler for the students of science and technology it is necessary to adopt the task-based approach in the EST classroom. Beginning with the theoretical discussion, the teacher can provide examples after inviting examples from students. Then tasks – individual, pair or group- can be initiated to apply the theory discussed. The task-based approach can also be used for teaching some aspects of language such as grammar and vocabulary also.Ultimately this task-based approach will lead to learner autonomy as the students are involved in discussion and feel interested in the tasks such as listening, reading, speaking, observing, demonstrating and brainstorming.

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