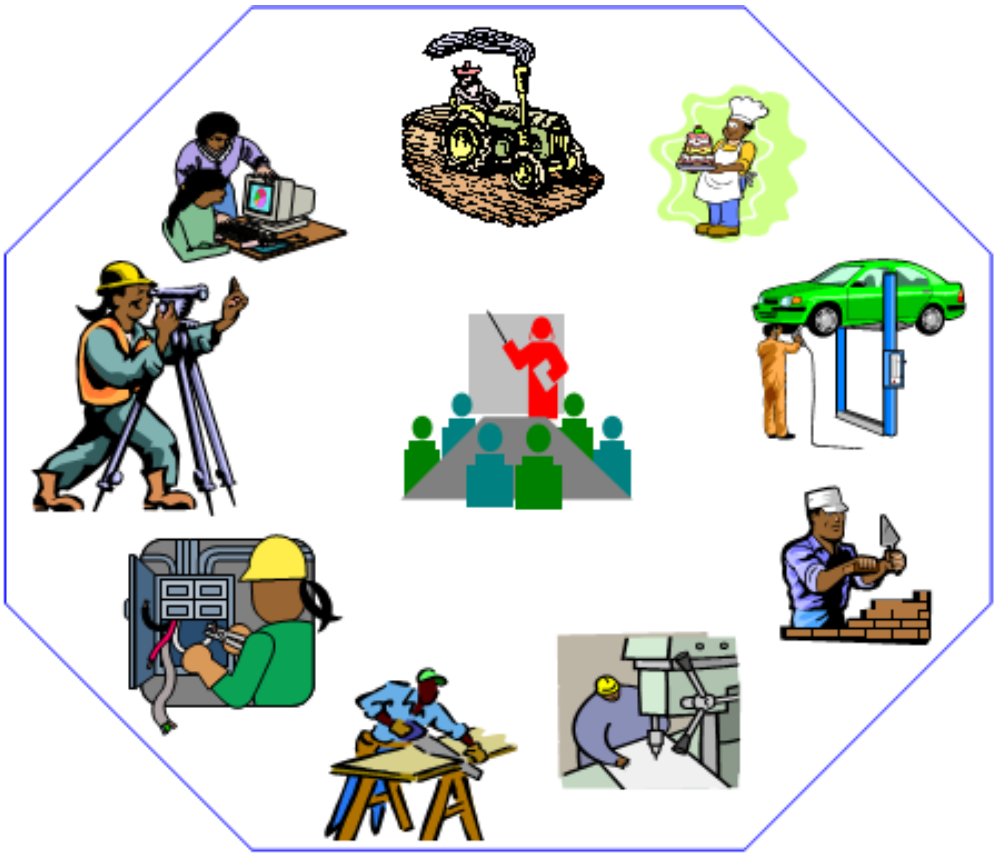
Lapidary
Level-I

Based on January 2014, Version 1 OS and April. 2021, V1 Curriculum



Module Title: - Handling Gem Materials
LG Code: MIN LAP1 M03 LO (1-4) LG (9-12)
TTLM Code: MIN LAP1 TTLM 0421 v1

April, 2021

Adama,Ethiopia

Table of Contents

LO #1- Prepare equipment for gemstone examination 3
Instruction sheet 3
Information Sheet 1- Selecting and examining methods and equipment 4
Self-check 1 13
Written test 13
Information Sheet 2- Preparing equipment and specimens 14
Self-Check – 2 18
Written test 18

LO #2- Perform gemstone examination 20
Instruction sheet 20
Information Sheet 1- Investigating the physical and optical properties of gem materials 21
Self-Check – 1 25
Written test 25
Information Sheet 2- Recording and verifying Examination results 26
Self-Check – 1 28
Written test 28

LO #3- Handle Gemstone material 28
Instruction sheet 28
Self-Check – 1 33
Written test 33
Information sheet 2:- Handling gem materials to minimize damage 34
Self-Check -2 36
Written Test 36

LO #4- Investigate and report examination results 37
Instruction sheet 37
Information sheet 2:- prepare examination results 38
Self-Check -1 41
Written Test 41
Information Sheet-2 42
Recording results 42
Self-Check -2 44
Written Test 44

Reference Book 45

AKNOWLEDGEMENT ..... Error! Bookmark not defined.

LG #9	LO #1- Prepare equipment for gemstone examination

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Selecting and examining methods and equipment**.**
- preparing equipment and specimens

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Selecte and examine methods and equipment.
- prepare equipment and specimens

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Selecting and examining methods and equipment

1.1. Introduction

Test Method: is a method for a test in science or engineering, such as a physical test, chemical test, or statistical test. It is a definitive procedure that produces a test result.[1] In order to ensure accurate and relevant test results, a test method should be "explicit, unambiguous, and experimentally feasible.

Test examining method in gemstone

Testing or examining evaluates the suitability of a specific stone for a particular application. The strength of the stone is tested to determine its resistance to crushing and bending.

The stone's wear resistance and slip resistance are crucial in flooring applications.

Generally Testing evaluates the suitability of a specific stone for a particular application .The strength of the stone is tested to determine its resistance to crushing and bending. The density, or specific gravity, is tested to design a support system capable of carrying the weight of the stone. The amount of water the stone will absorb (absorption rate) will help determine the resistance of the stone to staining and freezing. The stone's wear resistance and slip resistance are crucial in flooring applications.

Equipment:- the necessary item for particular purpose or set of tools or other object commonly used to acchive a particular objective.

Gemology examine equipment:-

- Refracto meter
- UV light
- Microscope
- Dicroscope
- Polariscope
- Densito meter
- 10 X loupe
- Hardness kit
- Dopping
- Tweezers

1.2. Selecting and examining methods

Proper handling of gemstones requires a knowledge acquired by undergoing different tests. Thus, the material has to be carefully examined.

The quality of examination method results is highly dependent on the methods which we use examine the material. Therefore, we have to select appropriate methods of examination to test characteristics of materials.

The common characteristics of materials to be tested include:

1. Color
2. Carat
3. Cut
4. Clarity
5. Luster
6. Fracture
7. Crystal form
8. Hardness
9. Specific gravity
10. Refractive index
11. Microscopic property

1. Color

Color:- Color is the most critical factor affecting the price of any gem variety at a given size. Color can be separated into three basic components: hue, saturation, and tone. Hue is what we usually think of as color. It is described by the name of the color of the stone (i.e., red, orange, yellow, green, blue, and violet.) Some hues are in-between two colors which are next to each other in the spectrum, this can be described by combining hues as in blue-green, red-violet, blue-violet, and so on.

Figure 1. Color gemstone

2. Carat

Carat is a weight that is equivalent to one-fifth of a gram. Originally gems were weighed in hand held balance scales with two pans. The gems were in one pan and carob beans were used on the other side. The word carat was derived from “carob”. Today we use electronic digital scales to weigh gemstones.

3. Cut

Cut refers to the shape of the gem, the proportions of the various parts of the gem, the finishing touches such as facet relationships, and, finally, the polish. Cut is critical in creating the full potential of beauty in a gemstone. It is most critical in diamonds, where color is a less obvious consideration.

The shapes available today are quite varied: rounds, ovals, cushions, pears, emerald or octagonal cuts, hearts, marquise, hexagons, half moons, triangles, and carved gems are a few of the possibilities.

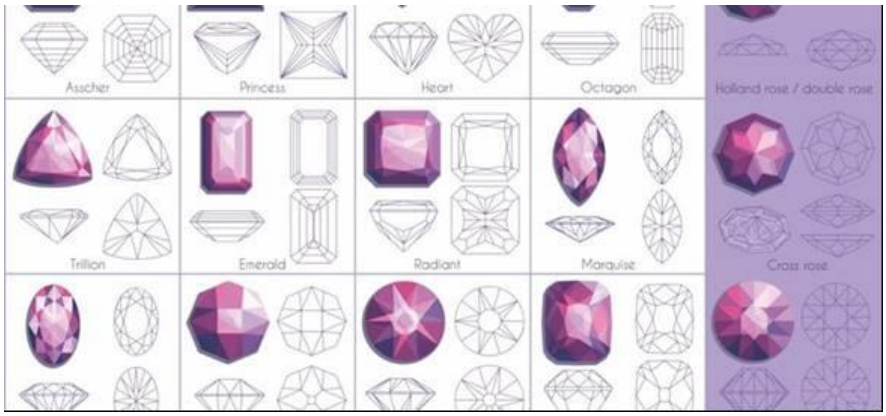


Figure 2. Types of cut

4. Clarity

Clarity refers to the internal landscape of inclusions that is inside the gem or blemishes that are on the exterior of the stone. The inclusions may be minute crystals of the same mineral, crystals of another mineral, tiny gas bubbles, small liquid filled pockets, internal fractures or cleavages, or any other visible matter inside the stone. These may form as one or more crystals or form in fine microscopic “clouds”.

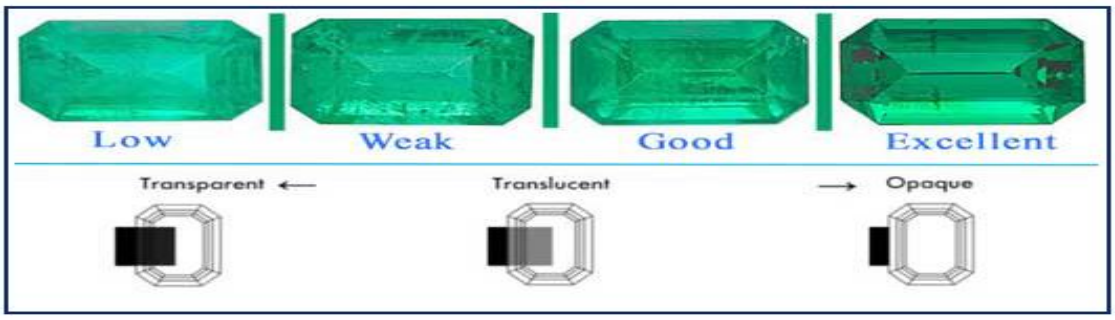


Figure 3. Gemstone clarity

5. Cleavage

Just as wood is easier to split with the grain than against it, gemstone cleavage is the tendency of certain crystals to break along definite plane surfaces. If there are planes in a crystal structure with relatively weak atomic bonds, the crystal is more likely to break along those planes.

Figure 4. Gemstone cleavage

6. Luster

Gemstone luster generally refers to a gem's base appearance. However, the gem's condition may affect its luster. A gemstone can have a polish luster (its appearance when polished) that varies greatly from its base luster. For example, polishing can transform jet, with a dull or waxy base luster, to vitreous.

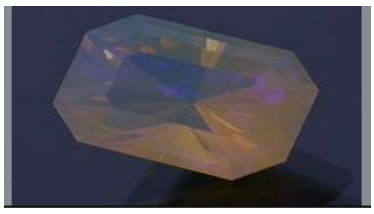


Figure 5. Gemstone luster

7. Hardness

Hardness refers to the scratchability of a gem. Hardness is rated on a scale from one to ten called the “Mohs scale”. The scale is not composed of even steps: the first eight minerals graduate in hardness on a more or less linear scale, but corundum and diamond are much harder. The distance between 8 and 9 and 9 and l0 is greater than any other hardness steps in the scale.

MOHS SCALE

- Talc
- Gypsum
- Calcite
- Fluorite
- Apatite
- Feldspar
- Quartz
- Topaz
- Corundum
- Diamond

Some minerals will have a variation in hardness within one crystal depending on the direction in which it is scratched.

The Mohs Scale of Mineral Hardness ...

Figure 6:- Mohos scale of mineral

Source:-hardness+of+minerals&hl=en&source

8. Density(Specific gravity)

Another very important property of gemstones is the density, which means the weight per volume. In most cases it is in the units of gramme per cubic centimetre (cm3). So if we have a certain gemstone cut as a cube of the size of 1cm to 1 cm to 1cm, we just can measure the weight of this cube and that value will be the density of this cube.

In most cases rough gemstones have an irregular shape therefore we have to calculate the density of the samples by taking two measurements and calculating the balance. At first we have to determine the weight of the stone in air and then we have to measure the weight of the sample in a liquid of a known density. In most cases the best liquid is pure water with just a drop of liquid soap in it.

Figure 4: Determination of the weight of a sample

Figure 5: Determination of the weight of the "basket" in water

Figure 6: Determination o the weight of the sample i water with the basket

Figure:- 7 Densitometer

9. Refractive Index

The way in which a gemstone refracts light through itself is another physical property which is used to identify gem minerals. The most suitable method for assessing the refraction of light is by using a refractometer. The working principle is as follows: If light goes from air into a more dense material like a gem the light will change a little bit its direction

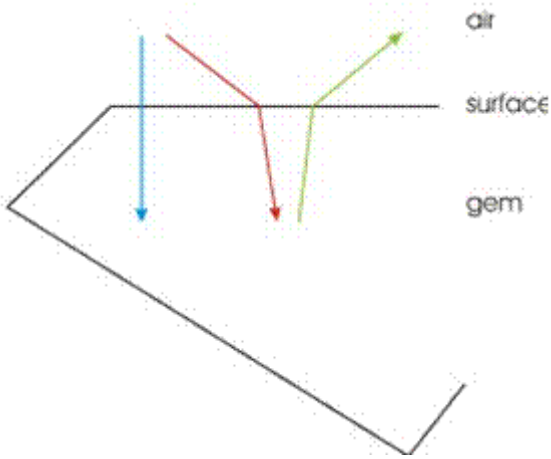


Figure 8:- Refraction of light

The change in the direction of the light is called refraction. With increasing difference in the density of the materials the refraction increases. These values are called refractive indices. Refractive indices are very characteristic for all gem material. In Figure 9 a diagram of a refractometer is shown.

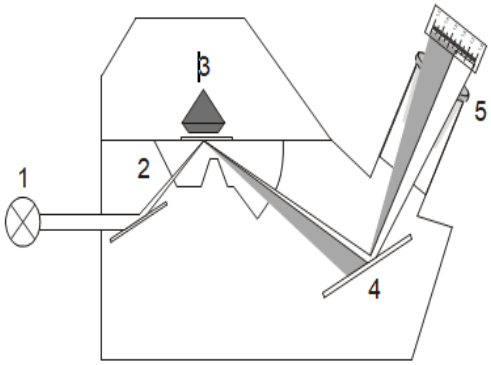


Figure 9:-Diagrame of refractometer

Key

1 = light source with just one certain colour
2 = Glass of high refractive index
3 = Gem sample
4 = Mirror and scale
5 = Filter

To learn how to work with a refractometer, let us start with a practical example. At first we have to put a little bit of refractometer fluid on the glass body. In the next step we put our red stone on the glass (see Figure 10).

Figure 11.Refractometer

Now we look into the refractometer and see a border between a bright and a darker area. This border gives us the refractive index of our red stone. In our example the value is 1.620

1.3. Gemstone Testing Equipment

Quality of testing equipment too affects the quality of the Gemstone end result.

Thus,the examination equipments should be properly selected.

Basic equipments which are used to identify gemstones are described below:

Table 1.1. Gemstone equipment and their use

Equipment	Relvant characteristics	Image
Microscope	The zoom capabilitiy of a microscope used in gemology ranges from 10X to 90X magnification. 45X is sufficient for most gemological purpose.	
Polarioscop	The polariscope may be one of the most underestimated tools in gemology. Most gemologists use it to quickly determine if the stone at hand is isotropic or anisotropic or, at best,	

	to determine the optic character of gemstones.	
Dicroscope	The dichroscope is very useful to separate gemstones having similar appearance. Colorless gemstones cannot be tested using a dichroscope. If a gemstone (except colorless) is seen through the aperture and the instrument is rotated, it will show either one single color or two different shades of colors depending on the type of gemstone.	
Refractometer	The primary use of the refractometer is to measure the angle at which light traveling through the stone is bent or refracted. This is called Refractive Index (R.I.).Gemological refractometer also can be used to determine whether or not a stone is single or double refracting.	

Tweezer	The tweezers should have some sort of grip at the tips to hold the gemstones. Locking tweezers are good for holding a stone in a position that can be viewed later or passed to someone else to examine.	
Densitometer	The specific gravity (SG) of gemstones is a constant widely used in gemological property charts. Although not every gemologist enjoys doing an SG test, it is still a property which can be very useful when other general tests fail. The method of determination uses a hydrostatic balance.	
Hardness Kit	Most of the gemstones differ in their hardness. There are different ways to check the hardness. The easiest way is to scratch the sample with a mineral of known hardness.	

Self-check 1	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Mention at least four 4C's common characteristics of gemstones to be examined.(2pt)
2. What are the uses of the following equipments:
    - Hardness Kit(1pt)
    - Microscope (1pt)
    - Dichroscope(1Pt)
    - Refractometer(1pt)
3. How can type of testing equipment affect the quality of the outcome?(2 Pt)
4. Diffence between density and specific gravity of a substance?(2Pt)
5. What are factors that affect quality of gem material?(2Pt)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Preparing equipment and specimens

2. preparing equipment and specimens

2.1. Preparing examination equipments

Quality examination equipments have to be prepared as per the test work requirements. Be fore starting the work the equipments must be checked for their proper operation. The right equipment has to be prepared for the right requirement.

Loupe

You'll need magnification. Start with a good quality 10x (ten power) loupe . Some economy loupes on the market range from mediocre to very good quality. The best you can get, and the standard for diamond grading, is a color corrected triplet loupe . Triplet means it has three lenses, so there's no distortion near the edges. Color corrected refers to a coating on the lenses, so the color you see is accurate.Read our article on loupes for more information.

Microscope

You'll also need a microscope for studying inclusions. This is often the only way to separate natural gems from their synthetic counterparts. While the loupe is more portable, the microscope is easier on the eyes and offers higher magnification. A gem microscope has special features that aren't available on most microscopes, so be sure the microscopes you're considering are appropriate for studying gemstones. A minimum 40x stereo microscope is needed for gemstone identification, but, of course, more power is helpful. You'll be able to see more inclusions and greater detail under higher magnification. Higher power will sometimes mean the difference between making an identification or not.

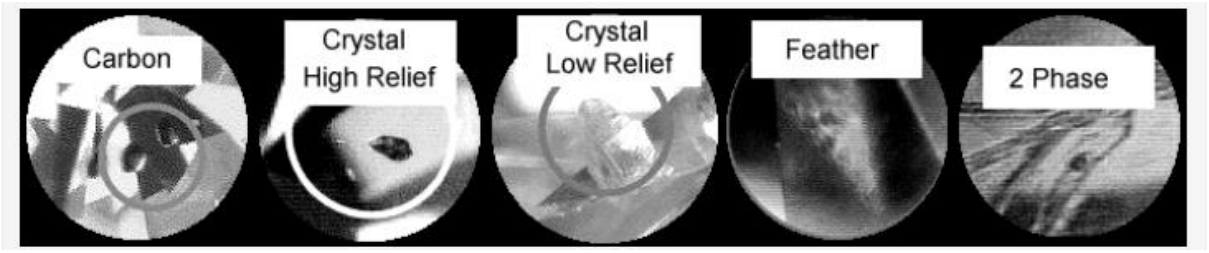


Figure 12 Microscope

Refractometer

Measuring the refractive index (RI) of your gems will be a high priority. You can do this with a microscope, but a refractometer is the best tool. Besides measuring the RI, a refractometer will give you the birefringence and optic sign of a gemstone.

In North America, the primary supplier of refractometers is the GIA. In Europe, the primary supplier is Krüss Instruments.

Another gem lab necessity is a means to measure specific gravity (SG). There are two methods for doing this. A balance beam scale can be used, provided one pan can be submerged in water. (That's usually easy to arrange). The other method is to use a set of heavy liquids." This is a collection of liquids with predetermined SGs. You determine the specific gravity of a gem by submersing it in the liquids and observing whether it floats or sinks.Heavy liquids have some disadvantages. They are toxic and flammable, so you must exercise care when using and storing them. Sometimes it's difficult to wash off the gem. Furthermore, your readings will always be estimates with heavy liquids. If you have an accurate scale, you can get a much more precise reading. There will be occasions when this is important, as a small fraction can sometimes confirm or eliminate a possible identification.

Dichroscope

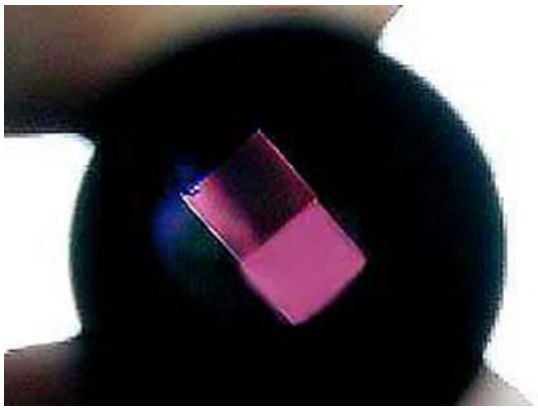


Figure 12 Dicroscope

The dichroscope is a small, hand-held instrument that separates the colors in dichroic materials. Its essential elements are two small pieces of polarizing material, oriented at 90º to each other, plus magnification. With a little thought and skill, you can actually make one yourself.

Preparing specimens

When observing the amazing minerals displayed in museums and collections, we marvel at their unique habits such as color, luster, and crystal shape. However, when these minerals are originally found, they don't quite look like that. They are muddy, rough, and overall unattractive. It takes proper cleaning, trimming, and preparation to make a rough mineral into a beautiful display specimen.

Figure 12 Mineral specimen

Method of cleaning and preparing specimens to make them display-worthy.Small or fragile pieces are saved from this process to protect them. Once hosed and cleared of heavy mud and dirt, take the specimens and either spray them with a high-pressure cleaning gun, or scrub them with an electric toothbrush head.

Some minerals are soluble or sensitive to water, and therefore cannot be washed. Minerals such as the micas will absorb water and start flaking, and minerals such as Halite will dissolve. Though the vast majority of minerals are resistant to water, it is important to know which ones are not so that no damage will occur during washing.

Some minerals require more extensive cleaning, which water alone will not accomplish. For example, sometimes there is an ugly brown layer of iron oxides coating a specimen, or there could be an undesirable coating of Calcite. For iron oxides soak the mineral in Super Iron Out for a day or two, and for Calcite removal soak the mineral in Lime Out (an easily available strong acid), which burns off the Calcite after a few days. Some minerals will get destroyed when using such chemicals or solvents, so it is important to know which minerals can handle different cleaning procedures. Much of this is learned from experience and trial and error.

Once cleaned, proceed to trimming. often do some rough trimming prior to a good water scrubbing, but perform a more precise and careful trimming after cleaning. Basic trimming involves gently chiseling extra parts of unwanted matrix or damaged crystals, and more intense trimming requires more effort such as smashing parts of matrix with a sledgehammer to reveal and better expose crystals. A hammer can

also be used to smooth any undesirable rough or jagged edges on the matrix. This job has to be done very precisely, as imperfect trimming can totally ruin a display specimen.

Orientation is very important. A specimen able to sit on its own is most desirable. If possible, the main part of the display specimen should be centered on the matrix. Sometimes a matrix needs to be sawed flat on its bottom to properly size and position it. Matrix specimens are more desirable than free-standing crystals, so it is important to try to preserve the matrix when trimming. Unfortunately, crystals have a nasty habit of popping out of their matrix during specimen preparation.

When trimming or preparing minerals, good specimens will sometimes break in the process, though skillful preparation can usually prevent this. Fragile specimens may also break during handling. Occasionally, a specimen breaks with a clean fracture that can be easily repaired by gluing the two pieces together. This is especially true of a complete crystal that smoothly pops out of its matrix. A good repair job can make the specimen look almost as good as original, and a bad repair job can leave spaces in the contact area or glue stains.

A repair in a mineral will reduce its value. Poorly repaired minerals will have a highly reduced value. Though naturalists are against repairing minerals, most collectors are okay with the process as long as this is clearly disclosed when the mineral is purchased. For a dealer to sell a mineral that has been repaired, without having it clearly labeled as repaired is devious and dishonest.

Self-Check – 2	**Written test**

Part 1:Short answer items

Instruction1- briefly answer the following questions(2 pt. each)

1. What is the equipment used to measure the refractive index of gem materials?
2. What is gem material specimen?
3. How can type of specimen affect the end result of examination of gem material?

Part 2. Multiple choise Question(1 Pt each)

1) Gemology is best described as studying
A. Gemstone color, hardness, and clarity
B. Gem origins
C. The physical and optical properties that make gems unique

2) A gem microscope should have a minimum magnification of
A. 30x
B. 40x
C. 60x

3) A dichroscope is a small hand held instrument used to
A. Measure the dichros of a material
B. Separate the colors in dichroic material using two small pieces of polarizing material set at 45°
C. Separate the colors in dichroic material using two small pieces of polarizing material set at 90°

4) A polariscope is used with a strainless sphere to determine
A. If material is doubly refractive
B. A material's optic sign
C. Strain and twinning in a material
D. All of the above

5) Streak testing uses
A. Unglazed ceramic tile
B. A brick
C. Any hard, coarse material
D. None of the above

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

LG #10	LO #2- Perform gemstone examination

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Investigating the physical and optical properties of gem materials**.**
- Recording and verifying Examination results

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Investigae the physical and optical properties of gem materials**.**
- Record and verify Examination results.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Investigating the physical and optical properties of gem materials

Investigating the physical and optical properties of gem materials

Once the right examination methods and right equipment are selected, the next step is investing physical and optical properties of gem materials.

Physical Property of mineral

Each mineral species has unique and identifiable physical properties.

These include:

1. Color/Appearance
2. Luster
3. Streak
4. Hardness
5. Cleavage/Fracture
6. Form and habit (Shape)
7. Tenacity

1. **Color/Appearance**

- ✓ Can be misleading
- ✓ Many minerals will have a similar appearance, but will have different impurities
- ✓ Color and appearance are not enough to distinguish minerals

Figure 13.Color of gemstone

2. **Luster**

- ✓ Luster refers to the way a mineral reflects light from its surface
- ✓ Metallic = shiny like metal
- ✓ Non-metallic = dull, non-shiny surface, can include pearly, silky, and glassy
- ✓ We can also use toher terms such as waxy, pearly, glassy, dull, and silky

Pyrite has metalic luster Calcite has non metalic luster

Figure 14 Gemstone luster property

3. Streak

- ✓ The color of the powdered form of the gemstone
- ✓ We find a minerals streak by rubbing it on a white ceramic plate
- ✓ The color of the streak can be different than the mineral
- ✓ Gemstone must be softer than the streak plate

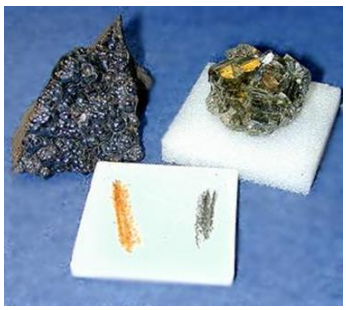


Figure 15 Streak property of gemstone

4. Hardness

- ✓ How easily a mineral scratches materials
- ✓ Mohs Hardness Scale

- ✓ Scale from 1 (softest) to 10 (hardest)

✓ Test by seeing if the mineral can scratch different objects (like human fingernail, copper, penny, glass, steel file)

Figure 16. Hardness of minerals

5. Cleavage/fracture

Cleavage & Fracture

✓ The way the mineral breaks

✓ Cleavage—minerals break along smooth, flat surfaces and every fragment has the same general shape

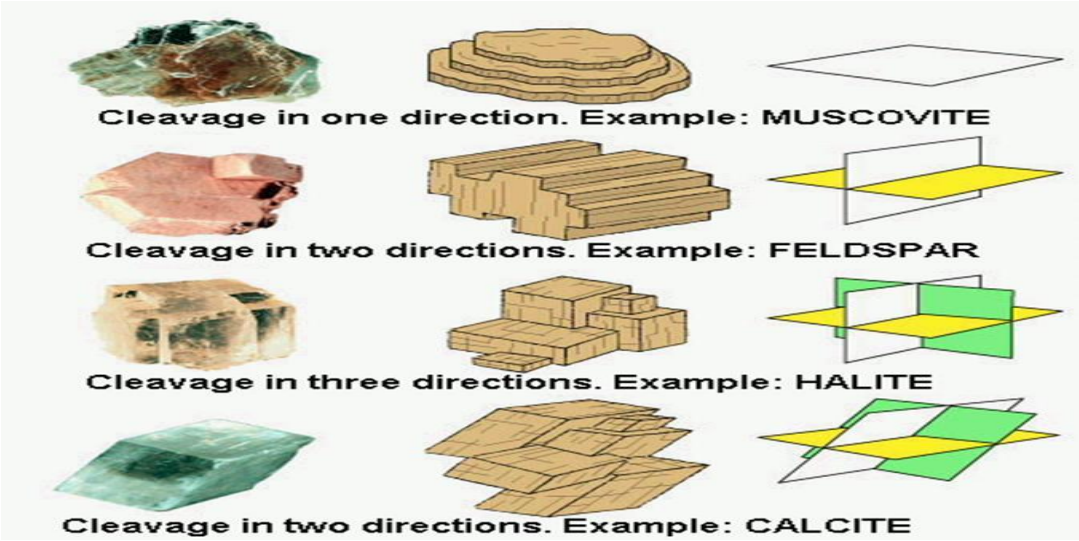


Figure 17.Mineral cleavage

Can have 1 plane of cleavage (ex. = Biotite)

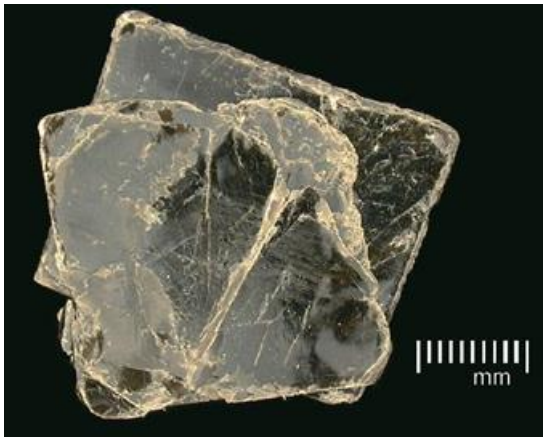
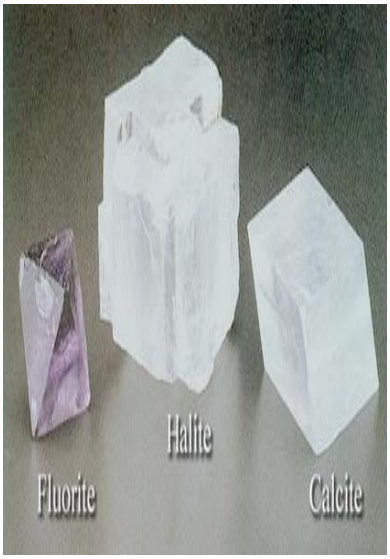


Figure 18. One plane mineral cleavage

- ✓ Can have multiple planes of cleavage



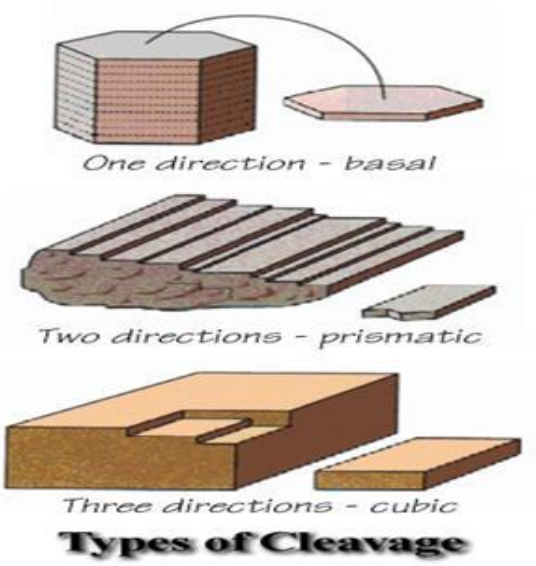


Figure 19 Multiple clevage

- ✓ Fracture—minerals that break at random with rough or jagged edges
- ✓ The way a substance breaks where not controlled by cleavage
- ✓ If minerals break with curved fracture surfaces, it is called concoidal fracture
- ✓ This is seen in glass, the igneous rock Obsidian, and the mineral Quartz

Figure 20 Mineral Fracture

Optical Property of gemston

- Colour Transparency

- Refractive index
- Anisotropism
- Dispersion
- Reflectivity
- Absorption
- Pleochroism
- Special optical effect
- Luminescence

Optical Phenomena results from the way light interact with the crystalline structure of a gemstone. This interaction or interference can be in the form of light scattering, reflection, refraction, diffraction, absorption or transmission.

Self-Check – 1	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is the difference between cleavage and fracture? (3pts)

2. List atleast four types of physical property of gemstone (2pts)

3. What is optical property?(2pts)

4. Name four instrument used for measure optical Property of gemstone.(4pt)

Note: Satisfactory rating - 8 points **Unsatisfactory - below 8 points**

Answer sheet

Test I

Score = _____

Rating: _____

1._____

2. _____

3. _____

4 ._____

Information Sheet 2- Recording and verifying Examination results

2.1. Recording of examination results

Methods of examining properties of gemstones have been described in information sheet-1 of this learning guide. Thus, you can read there and beyond as you like.

While examining gemstones for their properties, the corresponding findings have to be recorded for future analysis and decision making.

2.1. Verifying examination results

Verifying is checking what we want to prove by analyzing examination results. Here, we can make decisions about the properties of gemstones and thus we can identify the gem material in which have conducted the examination.

Note: The predetermined tabular values of the properties of a gem material is should be a reference for comparing the newly found results to judge the identification process.

operators trained in the same way might have slightly different actions or criteria for decision making, which causes variation. Not all variation caused by human action can be considered human error, although that possibility also exists.

Table stracture

Laboratory Report Title-Grading report	
Registration No	
Shape and Cut	
Style	
Carat/ Wieght	
Identification	
Varity	Type of gemstone
Specious	Natural/Synthetic
Color	
Transparency	
Clarity	
Optic character	
Refractive index	
Specific gravity	

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions (2pts each)

1. What is the advantage of recording test results?
2. How can size of a material specimen affect the end examination result?
3. What will included in test result of gemstone?

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Answer sheet

Test I

1._____

2. _____

3._____

LG #11	LO #3- Handle Gemstone material
Instruction sheet	

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Identifying handling measures appropriate to gem material
- Handling gem materials to minimize damage.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Identify handling measures appropriate to gem material
- Handle gem materials to minimize damage.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1	Identifying handling measures appropriate to gem material

1.1. Identification of handling and storage measures

Depending on their differences in physical and chemical properties, gemstones require different cares in handling. Example, gemstones with physical property hardness, softer stones should not be stored with harder stones as harder gemstones may scratch softer stone and damage them. Likewise, depending on the thermal properties of gemstones, gems have to be treated accordingly. Heat sensitive gemstones like opal should be stored in a low temperature area than others with less heat sensitive properties. Thus, identification of appropriate handling measures to different gemstones as per their properties is very important to safeguard gemstone

1.2. Gemstone care instructions

We use semi-precious and precious stones in our jewelry. Some stones are more fragile than others and need to be handled with care.

Diamond: Any stone, including a diamond, will break if it's hit hard enough in the right place. Toughness is a measure of how well a gem can survive an impact and resist breaking, chipping, or cracking. Diamonds are tougher than any other gemstone, however a hard blow can still cleave a diamond. Diamonds are invulnerable to virtually all acids and chemicals, but sudden and extreme temperature changes can cause thermal shock and create fractures and cleavages or cause existing ones to spread. Diamonds can be cleaned safely with lint-free cloths, commercial jewelry cleaning solutions, and household detergents. Harsher cleaning methods are not recommended for home use. These include powdered abrasive household cleansers, ultrasonic cleaners, and steam cleaners.

Figure 23 Diamond

Emerald: Emerald requires more care in wearing than ruby or sapphire. Heat can damage emeralds, and chemicals can cause the stone to alter in appearance or deteriorate. Ultrasonic vibrations and hot steam can weaken stones. Using warm, soapy water coupled with gentle scrubbing is the safest way to clean emeralds.

Figure 24 Emerald

Ethiopian opal: Also known as the hydrophane ("water-loving") opal, these opals absorb water much like a sponge. If an opal is left underwater, its brilliance may change from opaque or semi-translucent to translucent or transparent. It is best to remove an opal ring or necklace when showering or bathing, or if you know you will be swimming for long periods of time. If your opal does change from translucent to transparent, it will revert back to its original state once dried, however this may take a few days. Please note that extended time spent in water can irreversibly harm an opal, even if the damage is not immediately apparent. Opals can become dry if stored improperly. They are best stored in a soft cotton cloth, or with a piece of cotton wool dabbed with a few drops of water. Opals are also vulnerable to cracking if exposed to rapid changes in temperature. To clean an Ethiopian opal, never use a steamer or ultrasonic, keep away from harsh cleaning agents, perfume, high temperatures or sudden temperature changes. Simply wipe with a clean soft cloth.

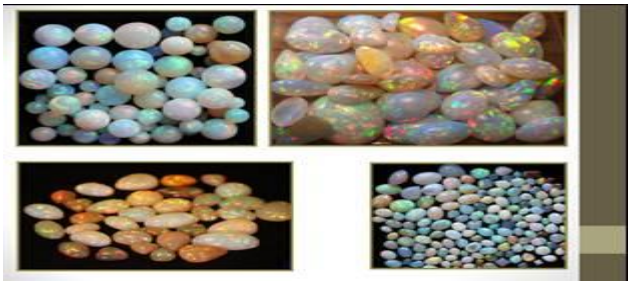


Figure 25 Ethiopian Opal

Moonstone: Moonstone is prone to breaking if knocked hard. High heat or sudden temperature change can cause breaks in moonstone. Please use warm soapy water for cleaning—ultrasonic and steam cleaners are never recommended.

Figure 26 Different type of monostone

Sunstone: Sunstone is vulnerable to damage if knocked too hard. Exposure to heat is not recommended for sunstone, but its color is stable when exposed to light and won't fade. Warm, soapy water is always a safe sunstone cleaning method. Ultrasonic and steam cleaners should be avoided. Cleaning products containing bleach should also be avoided. These stones should only be cleaned with warm, soapy water.

Topaz: Topaz requires special care. It is a relatively soft semi-precious gemstone, so a hard blow might split it, and extreme pressure or sharp temperature changes might cause it to break. Topaz is affected only very slightly by chemicals, but please take care when washing your hands with abrasive soap, or when cleaning with chemicals. t's important to avoid steam or ultrasound for cleaning topaz: Warm, soapy water works best.

Figure 27 Sunstone

Turquoise: Though turquoise is stable to light, high heat can cause discoloration and surface damage. It dissolves slowly in hydrochloric acid, and it can be discolored by chemicals, cosmetics, and even skin oils or perspiration. It's safe to clean turquoise jewelry with warm, soapy water, but it should never be cleaned with steam or ultrasonic cleaners.

Turquoise is an opaque, blue-to-green mineral that is a hydrated phosphate of copper and aluminium, with the chemical formula CuAl6(PO4)4(OH)8·4H2O. It is

rare and valuable in finer grades and has been prized as a gemstone and ornamental stone for thousands of years owing to its unique hue.

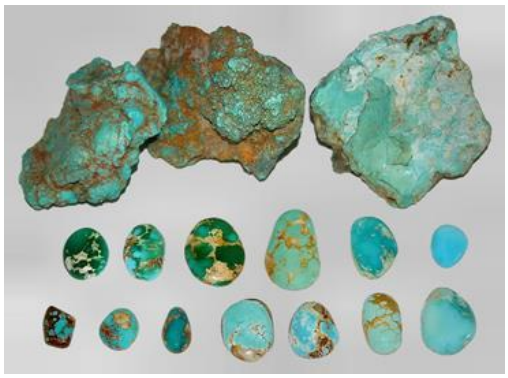
Colour: Turquoise, blue, blue-green, green

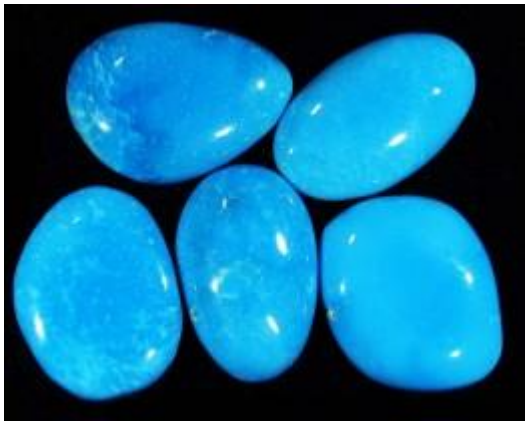
Category: Phosphate minerals

Mohs scale hardness: 5–6

Strunz classification: 8.DD.15

A. Rough blue turquoise





B.Green turquoise C.cabocon turquoise

Figure 29 Turquoise

Self-Check – 1	**Written test**

Direction 1: Short answer items(2Pts each)

Instruction1- Read the following questions and give answers for each.

1. How can the characteristic of a material affect its handling?
2. Which gem material is stable in light and instable in hot environment?
3. Describe the handling techniques of Ethiopian opal.

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Answer Sheet

Score = _____

Rating: _____

Information sheet 2:- Handling gem materials to minimize damage

2.1.Gem material Handling

Having identifying the appropriate gemstone handling and storing measures, implementation of those of those measures should be a critical to safeguard gemstones and thus wealth that we can create from them.

2.2. Proper Care of Your Gemstones and Crystals

In addition to cleansing your gemstones and crystals from all forms of impurities, proper handling and care are also crucial to the life and effectiveness of your stones. Here are some important tips for you to remember in order to ensure that your gemstones and crystals are not only properly cleansed, but also kept and handled in a way that will maximize their effectiveness.

• **Never leave your gemstones and crystals on rough surfaces.**

Your stones may get scratches and incur minor damages, which can affect their performance. The luster of your stones will also be affected.

•**When leaving your gemstones and crystals out in the sun, make sure that you do so only within the allotted time frame.**

Leaving your gemstones and crystals out in the sun and forgetting about them affects the quality of the cleansing process. Remember that cleansing your stones requires your involvement, not just on a physical level, but on a psychic level as well. This means that you should be attuned to your stones, knowing when they are thoroughly cleansed, and when they need to be cleansed again.

•**When traveling with your gemstones and crystals, wrap each stone separately in a natural fabric like cotton, silk, or pure wool.**

Each stone has to be separately wrapped because each stone has different energies. Also, do not place heavy objects on top of them, even if they are securely wrapped in a thick material.

•**Do not store your gemstones and crystals in places where their energies can be**

disrupted.

Electromagnetic fields from televisions, computers, and certain mobile devices may disrupt the natural flow of energies within your gemstones and crystals. Try not to store or display them near these electronic devices. Knowing how to properly cleanse and care for your gemstones and crystals is as important as knowing how to use them. If you do not take proper care of your gemstones and crystals, it will affect your connection and relationship with them, as well as how they perform for you. Gemstones and crystals are more than just beautiful rocks. Gemstones and crystals are alive – they pulsate with powerful energies, and are connected with the consciousness of the Universe. It is wise to treat them with respect, and to use them properly. What they can do for you in return is only limited by your imagination and knowledge.

Self-Check -2	Written Test

Direction 1: Short answer items

Instruction1- Read the following questions and give answers for each.

1. What is the reason we separate gemstones while handling?
2. How can rough store affect luster of gemstones?
3. List down the proper techniques of handling gemstones?

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Answer sheet:-

1. _____
2. _____
3. _____

Score = _____
Rating: _____

LG #12	LO #4- Investigate and report examination results

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Preparing examination results
- Recording results.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- prepare examination results
- Record results.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information sheet 2:- prepare examination results

2.1. Examination results

While handling gemstone, you have done so many technical tasks from equipment preparation to conducting examinations/labs on their properties. Therefore, all those activities and the findings of the examinations have to be well documented and prepared as technical report format for any request possible and further decision making. This report may be finally examined by other higher level group of professionals.

Refer to learning guides,9 and 10 (Prepare equipment for gemstone examination and Perform gem examination) check technical tasks that have been performed .

The process for compiling a technical report

As with any writing, one of the first questions that must be asked in the planning process is "Who is the target reader?" In engineering practice, the reader can be a

client, a colleague, a manager or a junior. In academic writing, the target reader is usually the examiner. The examiner is normally independent and was not involved in the initiation or executing of the work being reported. The trainee must therefore ensure that sufficient background and detail is given to convince the examiner.

When technical writing is aimed at an examination process, the outcomes or assessment

criteria must be thoroughly accounted for in the planning of the writing. It will be of great benefit to the trainee to study the relevant assessment criteria.

The process of writing a technical report begins with planning the work on which the report is based. Even at this early stage, the task can be broken down into elements which are likely to become the chapters or sections of the report. The final sequence of the topics and sections will usually not correspond with the order in which the work was done, but will be determined by the desired structure of the report.

The general rule is to begin writing the sections of the report as soon as possible.The table of contents should be drafted very early in the process of writing the report since the table of contents provides a good overview of the entire document and, while the report is being written, provides an indication of which sections still need to be done.

Regardless of the order of the report, it should be written as soon as that part of the work

has been completed, for example when some apparatus has been developed or set up, a section of theory has been derived, It is also a good idea to give the written work to a fellow student or a supervisor as early as possible to criticize constructively. Some sections written as appendices in the early phases will remain appendices, while others will later be included in the main text and some will not be included in the final report. It is important to keep in mind that report writing is an integral part of the thought

process: it helps to define and order ideas and to derive well-considered conclusions so that further planning of the work can be undertaken

Self-Check -1	Written Test

Name_____**Section**_____**Id No**_____

Direction 1: Short answer items

Instruction1- Read the following questions and give answers for each.(2pts each)

1. What is the purpose of preparing and reporting examination results?
2. Who may be the last evaluator of our report?
3. What is include in test report?

Answer Sheet

1. _____

2. _____

3. _____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Recording results

While performing examinations on the overall properties of gemstones, the findings/results should be well recorded in a standard document for final decision making. The record format should be developed as per the need of the data to be collected and it should be the best descriptive. The examination procedures are presented in previous learning guides (10). Thus, refer the learning guides from 9 through 11 to remind again and use in the information and integrate with this particular topic.

Gem Identification reports for gem materials, mounted jewelry and ornaments. The identification tests, based on the chemical and physical properties of the mineral, are performed by GWLAB experienced gemologists. The process includes the use of traditional and highly advanced gemological instruments, supported by magnified observation.

Figure 31. Sapphire, Rubby and Emerald

The identification results include the gem type (variety and species/series), its descriptive properties (transparency, shape and cutting style, measurements and carat weight), its color (as perceived by the eye and according to the Gemewizard system), its clarity grade, the enhancements which the gem was subject to, a learned opinion regarding its country of origin, digital image(s) of the gem, digital Gemewizard reference color(s) of the gem and its precise location within the

spectrum, its commercial name (if applicable) and a 3D dimensional model of the gem.

Gem Identification and Grading Reports offers unique grading capabilities for multi-colored gems that are available only here. These include gems with color-change phenomena, bi-color gems and parti-color gems as well. In these cases, the color grade includes both the colors of the gem, as well as their precise locations in their respective spectrums. For parti-colored gems, the overall appearance of the gem's color and its main color components are depicted.

For materials identified as synthetics (laboratory grown) or man-made (such as glass), a LAB report is issued, distinctly stating the non-natural state of the gem. Thus our customers are always assured that all the necessary gem information has been disclosed.

Table. 2. Gemstone laboratory Identification report

Laboratory Report Title-Grading report	
Registration No	
Shape and Cut	
Style	
Carat/ Wieght	
Identification	
Varity	Type of gemstone
Specious	Natural/Synthetic
Color	
Transparency	
Clarity	

Additionally the type of cut and Picture of the gem is included in the report.

Self-Check -2	Written Test

Name_____**Section**_____**Id No**_____

Direction 1: Short answer items

Instruction1- Read the following questions and give answers for each.(2pts each)

1. What do we mean by integrity of test piece?
2. What is include in test report?

Answer Sheet

1. _____
2. _____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Reference Book:

1. Gem& Gemology :THE QUARTERLY JOURNAL OF THE GEMOLOGICAL INSTITUTE OF AMERICA
2. JOEL E AREM, PHD, FG.A.Color encyclopidiya of gemstone. Second edition
3. Smith sonian; Nature guide of rocks and minerals
4. W.Dan Housen and Wayne M.Shulterd Gemstone and other unique minerals and rocks of WYOMING; A field guid to collector

WEB ADDRESSES

1. **https://www.gemsociety.org/article/cleavage-gemology/**
2. https://www.gemsociety.org/article/handling-gems-securely/
3. https://www.gwlab.com/laboratory/identification/
4. https://gem-a.com/gem-hub/gem-knowledge/laboratory-reports-and-geographic-origin-of-gemstones
5. www.geology.com

AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of Amhara Regional TVET Bureau, Oromia Regional TVET Bureau, TVET College/institutions, Geological survey of Ethiopia, Ministry of Mines and Petroleum and Federal Technical and Vocational Education and Training Agency (FTA) who made the development of this training materials with required standards and quality possible.

The trainers who developed the curriculum

No	Name	Qualification	Educational background	Institution	Region	Phone Number	E-mail
1	Muluken Yenet	Bsc	Manufacturing	BDR PTVET college	Amhara	0973088981	mulukeynet@gmail.com
2	Jember Abera	BSC	Geography	DBB PTVET college	Amhara	0911040938	
3	Zebene	BSC	Geo chemist		Addis Ababa		
5	Abdissa Fufa	BSC	Geology	Manesibu TVET college	Oromia	+251935800724	
6							