

## Emeralds and other types of beryl, rubies and sapphires

### 1) Introduction

Today we will look at gemstones under the darkfield microscope. The goal is to see inclusions that might be characteristic of Natural and synthetic emeralds, rubies, and sapphires. This exercise should be read and done in conjunction with Chapters 15 & 16 of P. G. Reads, Gemology, 3<sup>rd</sup> Ed. You have already been assigned this reading, on inorganic gemstones and their synthetic gemstones counterparts.

#### Synthetic gems

Since around 1900, a little earlier perhaps, people have been creating synthetic gems in the laboratory. We will mainly see flux synthetic emeralds, though now hydrothermal emeralds are becoming more common. We will also see flame fusion rubies and sapphires and a few made by flux. Hydrothermal corundum (ruby and sapphire) is made, but is rare still.

First your instructor will discuss natural versus synthetic gemstones in general.

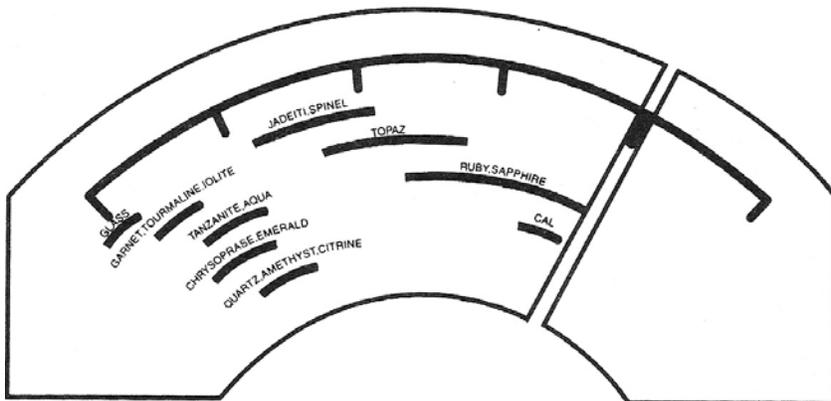
#### Natural Gems Versus Synthetic Gems

**Besides looking in the microscope where we may see characteristic natural and synthetic inclusions, you may also use some of the previously used instruments**

##### 1) The conductivity meter

Using the conductivity meter you may be able to distinguish between some red, blue, and green stones.

We can tell corundum from spinel and beryl (emerald) on the conductivity meter (below).



We cannot tell natural from synthetic with the meter. This is where microscopes come in.

The following list gives the colors of the common synthetic or imitations of natural stones

Corundum colors	Spinel colors	Glass	Synthetic beryl
Blue	Blue	Blue	
Red	Red is rare	Red	Red (rare)
Green	Green	Green	Emerald common
Pink	Pink possible	Pink	
Yellow		Yellow	
Orange (padparadscha)		Orange	
Purple (alexandrite)	Purple (alexandrite)	purple	
Colorless	Colorless	Colorless	

## 2) Using the Chelsea Filter to Test Emerald and Corundum (Ruby & Sapphire)

### INTRODUCTION

Some gemstones appear to change color when viewed through the Chelsea Color Filter. This color change may identify some gemstones, distinguishing some emerald from green glass and some ruby from red glass. The Chelsea Filter also distinguishes many manmade gemstones. Cobalt-blue glass and blue synthetic spinel colored with cobalt can be told from natural blue stones. Often the presence of either chromium or cobalt makes the gem appear red color in the filter. However, there are many exceptions, the **presence of other elements, particularly iron interferes** with chromium's or cobalt's effect.

### HOW TO USE A CHELSEA FILTER

Hold the filter an inch or less from your eye. Shine a fiber optic lamp on the stone (or a strong light bulb). The stone may appear to change color when viewed through the filter. There is no need to hold the filter very close to the gemstone, even items in showcases can be examined providing they are lit by strong lights. It is a good tool to have when shopping, but it does not really guarantee a good quality stone will be found. Along with natural, many synthetic gems look red through the filter.

### HOW IT WORKS

White light is made up of all the colors of the rainbow (a spectrum Roygbiv is used as a pneumatic). Red, orange, yellow, green, blue, indigo, and violet make the rainbow. Colors are known, technically, as wavelengths of light. A gemstone will absorb some wavelengths and leave the others free to reach the eye. It is these **unabsorbed colors (wavelengths) that combine and give the appearance of color**. Emerald absorbs virtually all the yellow/green wavelengths; the Chelsea Color Filter filters out all but the yellow/green and deep red wavelengths using a combination of filters sandwiched together. Since the yellow/green has already been absorbed by the emerald, only red is left to pass through the filter.

However, if the red is blocked, by **say iron** that absorbs red, or **stops fluorescence**, in a stone, the stone may not have much color. **Many natural emeralds do not react to the filter.** However, some of the best, such as many **Colombian emeralds do** show a red color. Natural Burma rubies also show their red (it is most likely that fluorescence caused by strong light shined on the stone is really the cause of the red in rubies and perhaps in some iron poor emeralds).

#### THE IDENTIFICATION OF EMERALD WITH THE CHELSEA FILTER

Some natural and most synthetic emeralds will appear to change from green to red when viewed through the filter, glass and other green stones (such as tourmaline, except some chrome tourmaline) remain green/dark through the filter. The brightness of the red depends on the amount of chromium in the stone. There is no chromium in most green stones; in natural emeralds chromium is present in small quantities; in synthetic emeralds chromium is present in large quantities. Therefore green glass, peridot, green tourmaline, green sapphire, etc. appear green/dark through the filter; most natural emeralds will appear at least a little red (from dull red to bright red) through the filter, though **not many Brazilian emeralds**; synthetic emeralds will often appear a brilliant glowing traffic-light-red. However, some modern synthetic emeralds appear only a dull red and some natural emeralds do not appear red at all. The Chelsea Color filter, originally designed for testing emeralds, will give a good indication that you may, or may not, have an emerald but will not give a simple yes or no reading.

#### THE IDENTIFICATION OF BLUE SAPPHIRE WITH THE CHELSEA FILTER

Blue natural or synthetic sapphire will have no chromium, it is colored with iron and titanium and the iron will block any color change. However, **synthetic blue spinel imitating dark blue sapphire will be colored by cobalt and thus will appear red in the Chelsea filter.**

#### THE IDENTIFICATION OF RUBY WITH THE CHELSEA FILTER

Natural and synthetic rubies all will have chromium and may appear red with the Chelsea filter. If there is iron, the iron will block any color change. However, **synthetic Verneuil or Red Spinel imitating dark ruby will be colored by chromium and does not have iron, thus they will appear red in the Chelsea filter.** You then need to test the red stone with the spectroscope.

#### 3) TESTING RUBY WITH THE SPECTROSCOPE

Ruby will have two absorption lines in the blue, red spinel and red glass won't. Thus you can tell ruby from other red stones. Ruby will also show two colors with the dichroscope. **See Page of color plates in the larger textbook, just before page 149 for spectra.**

Check the spectrum of ruby. Natural ruby will have less chromium than synthetic and it may be harder to get a spectrum reading.

#### TESTING SAPPHIRE WITH THE SPECTROSCOPE

Sapphire does not have a strong spectrum (see color plate p 149).

## TESTING EMERALD WITH THE SPECTROSCOPE

Emerald does have a characteristic spectra with chromium lines, etc, but is not always easy to see.

Looking at Ruby, Sapphire, and Emerald with the Gem Microscope.

1) USE DARKFIELD UNLESS TOLD TO DO OTHERWISE.

2) In ruby you should see several inclusions. A) rutile, B) silk (a bunch of rutile), C) a flux inclusion in synthetic ruby (at least two Chatham and Ramaura, D) a crystal of something (possibly a zircon or calcite). E) We may will attempt to immerse a synthetic ruby to see Verneuil lines (curved growth lines) due to growth by flame fusion.

3) In sapphire you should see several features. A) rutile silk in a Linde star synthetic sapphire, B) color zoning in natural sapphire (some may be colorless zones and some zones are more intense blue. C) a zircon crystal with a halo (like a damaged area around the zircon)

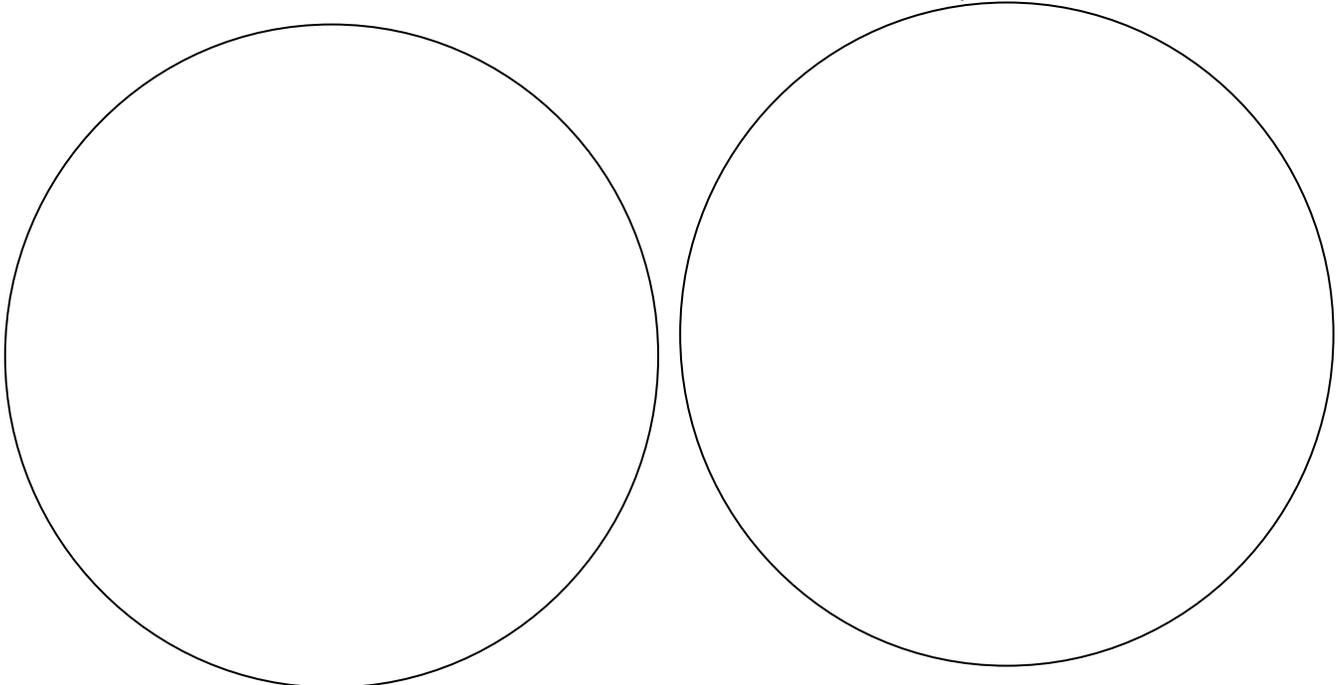
4) In emerald you will see several features. A) synthetic flux inclusions in Chatham emerald. B) Crackled pattern in a Lectleitner overgrowth emerald (p. 197). C) fibers inclusions in an emerald D) a two phase inclusion in emerald (a bubble in a liquid inside of a crystal).

## Ruby

A) Draw the rutile and silk (look at figure in book p. 199, P.G Read)

Give Magnification = ocular x objective.

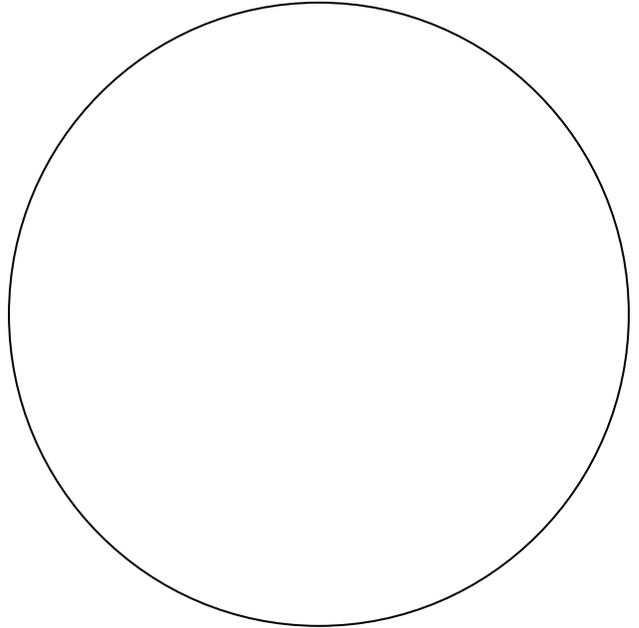
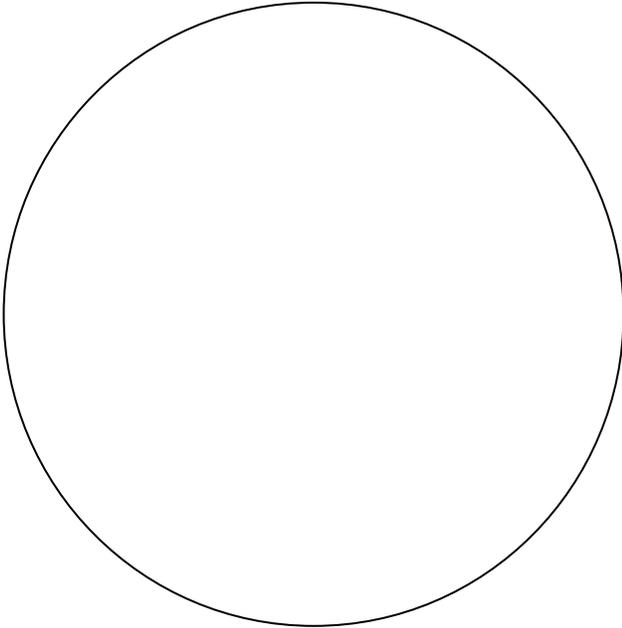
Rutile and cotton cloud Silk in a Burma ruby



**Draw a flux ruby** Give magnification of whole crystal and microscope view (object x ocular magnifications = Total mag.)

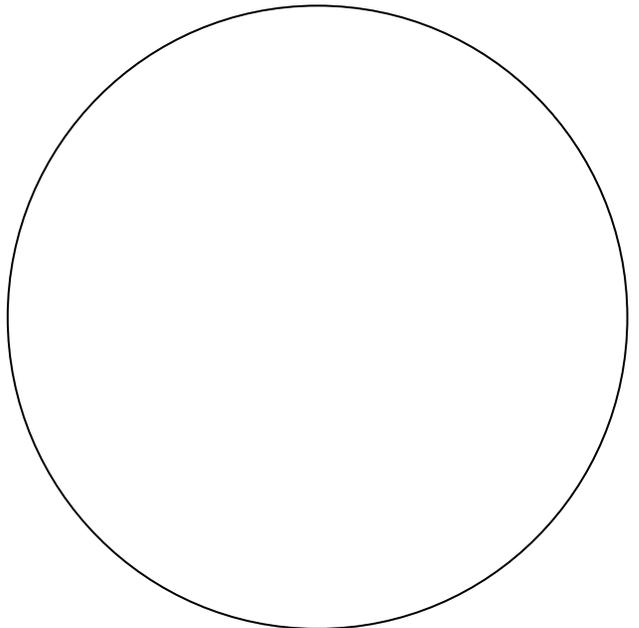
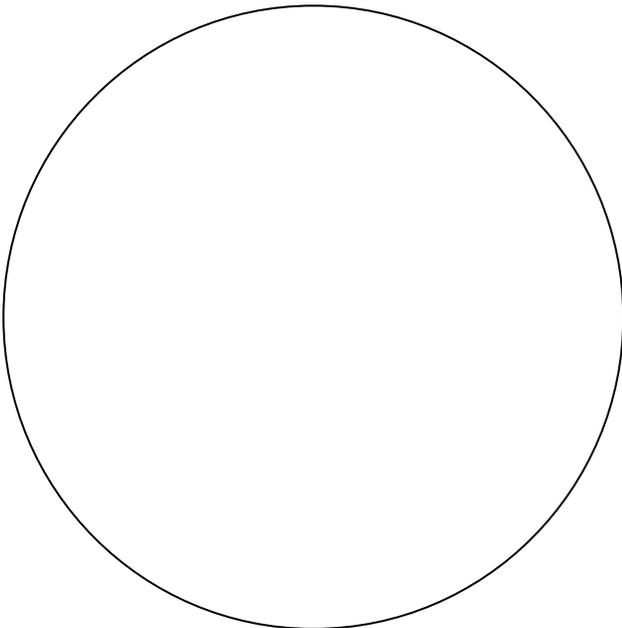
Ramaura Whole Crystal

Microscope view flux inclusion \_\_\_\_\_X



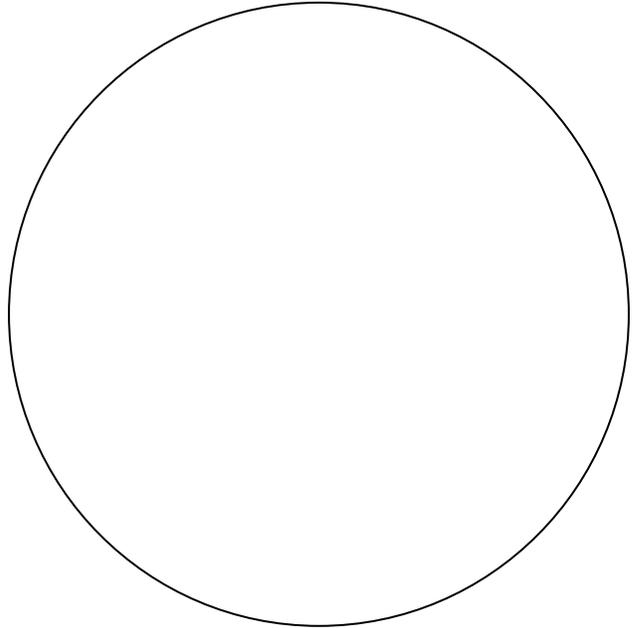
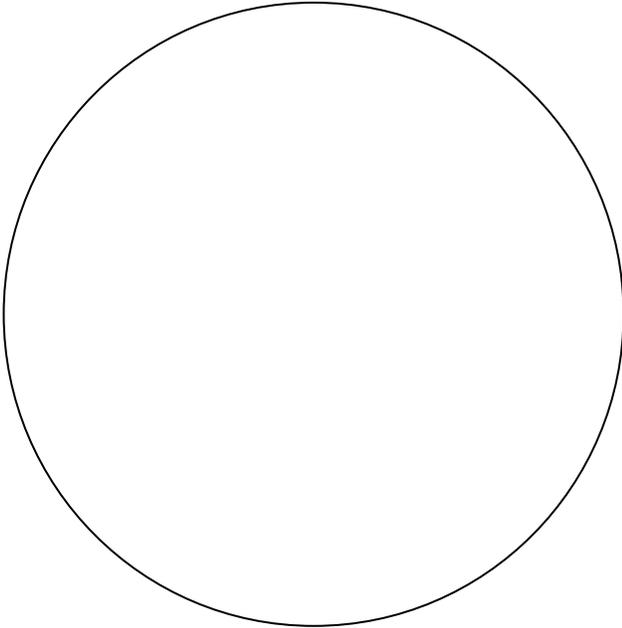
Chatham Whole Crystal

Microscope view flux inclusion \_\_\_\_\_X

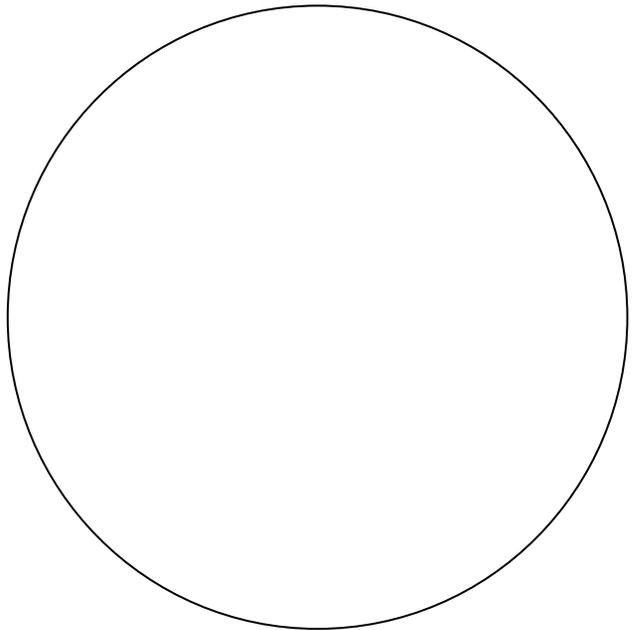
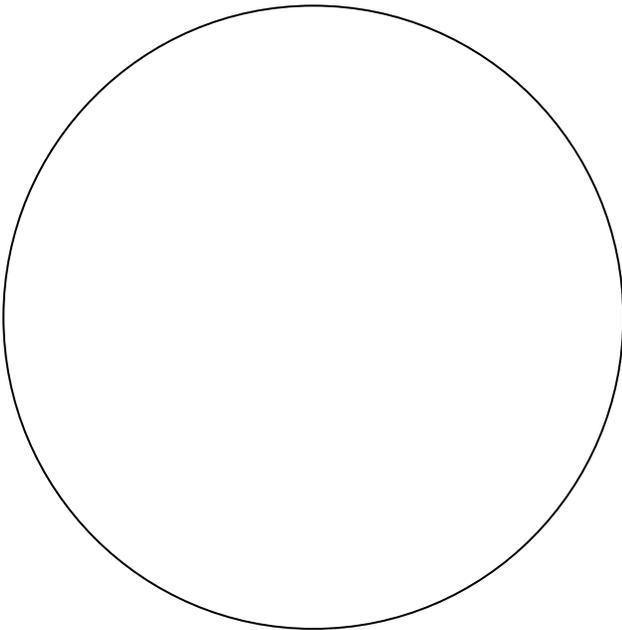


**Draw a crystal in a flux ruby** Give magnification of whole crystal and microscope view (object x ocular magnifications = Total mag.)

Chatham Whole Crystal \_\_\_\_\_X Microscope view crystal or platinum inclusion \_\_\_\_\_X



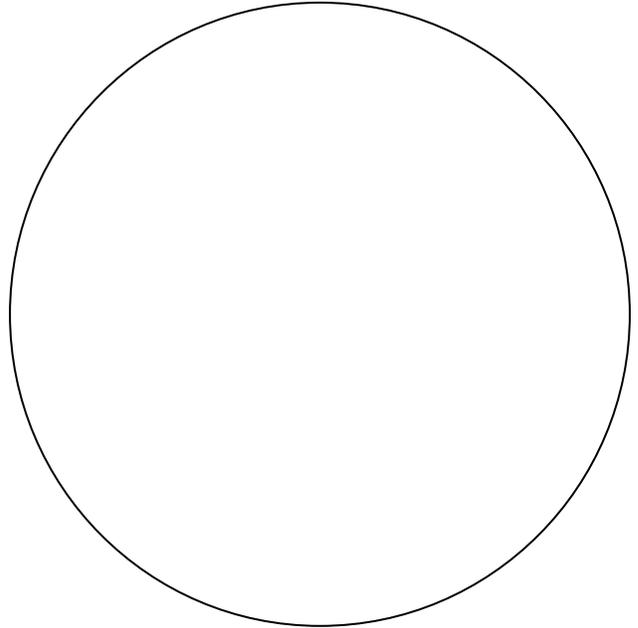
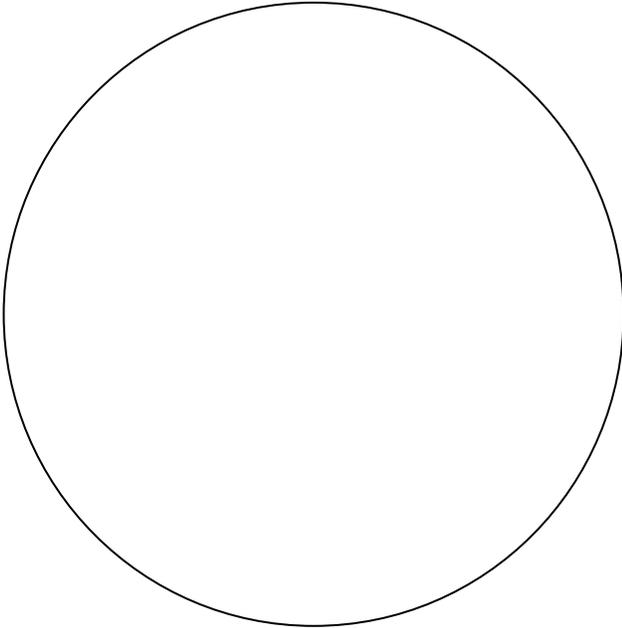
Ruby Whole cut stone Verneuil \_\_\_\_\_x Curved growth lines and bubbles, etc \_\_\_\_\_X



Draw a Linde Star synthetic sapphire Give magnification of whole crystal and microscope view (object x ocular magnifications = Total mag.)

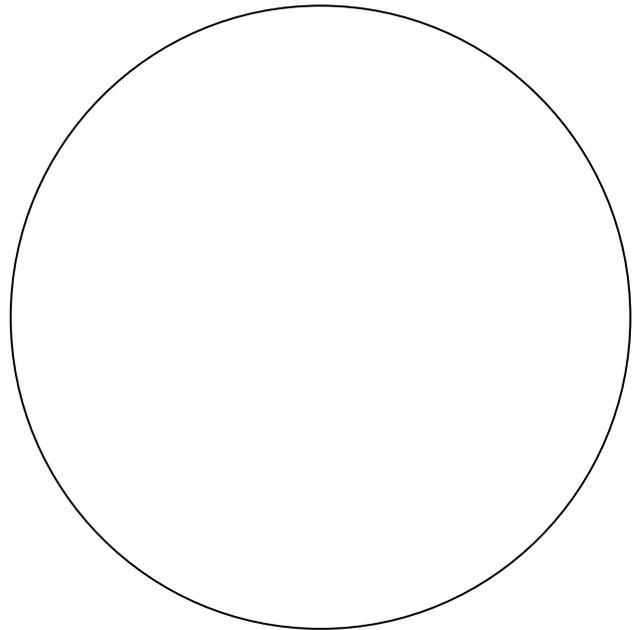
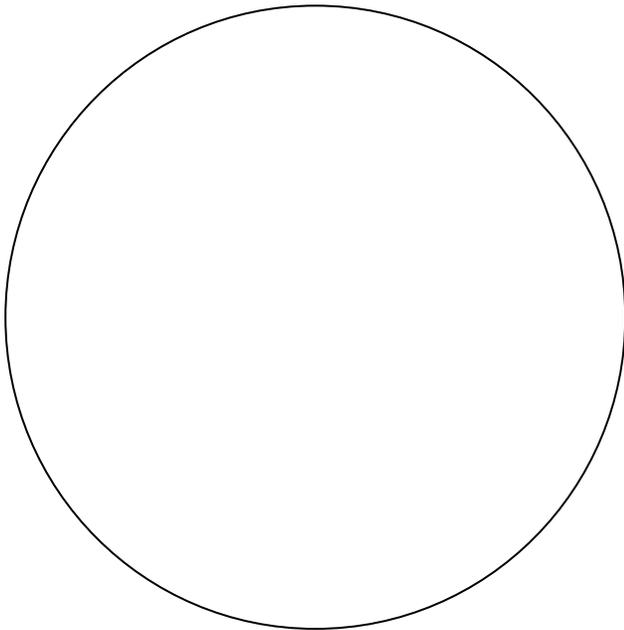
Whole stone \_\_\_\_X

Microscope view flux inclusion including rutile silk \_\_\_\_\_X



Whole cut stone Australian sapphire

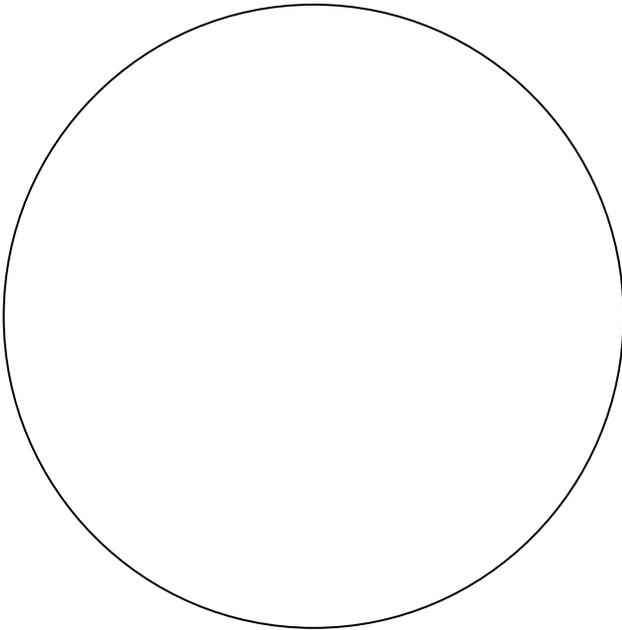
Microscope view of zoning in sapphire \_\_\_\_\_X



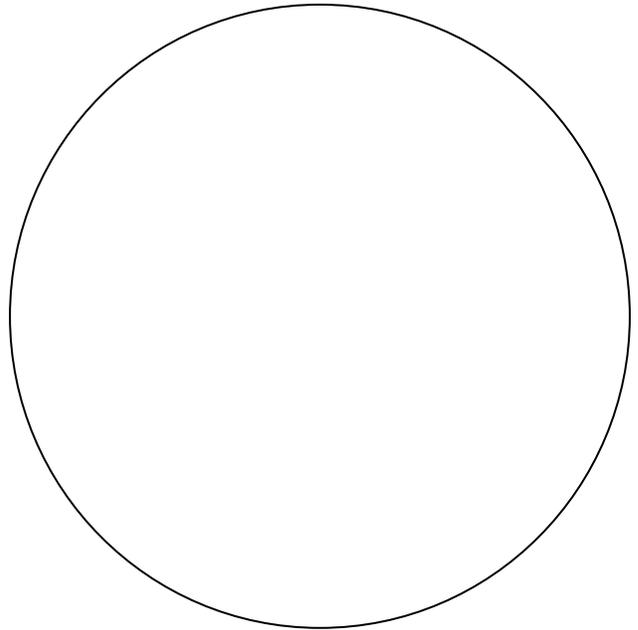
Draw a sapphire with a zircon inclusion. Give magnification of whole crystal and microscope view (object x ocular magnifications = Total magnification.)

Whole cut stone \_\_\_\_\_X

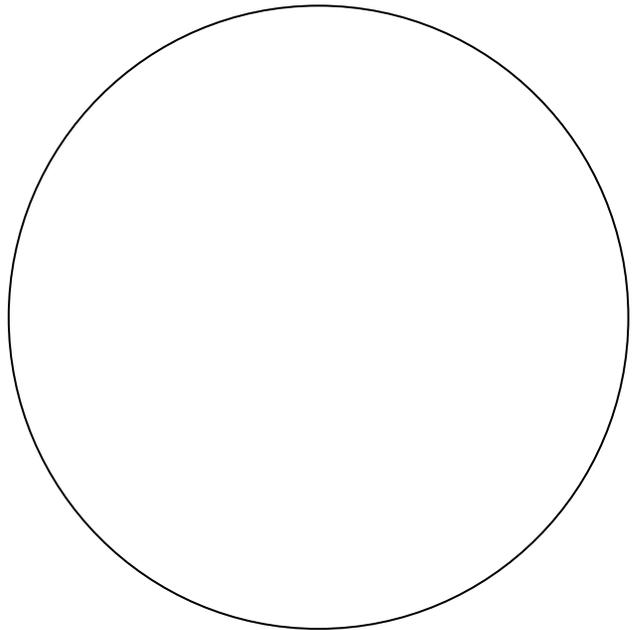
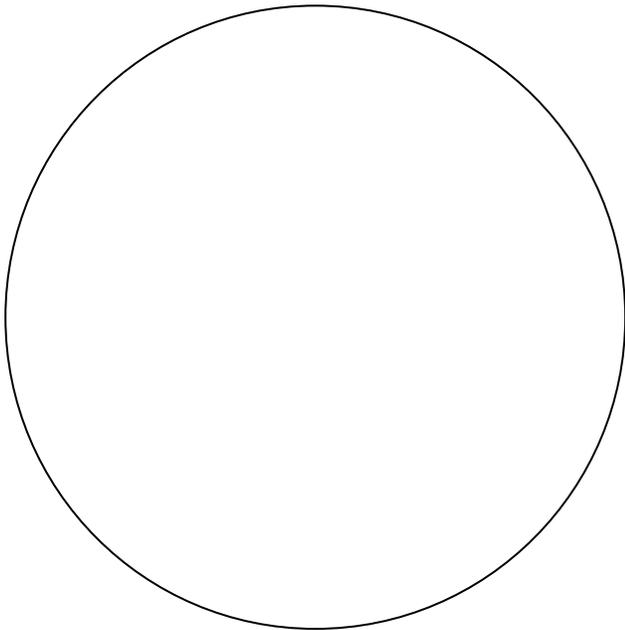
Microscope view zircon crystal inclusion \_\_\_\_\_X



Extra



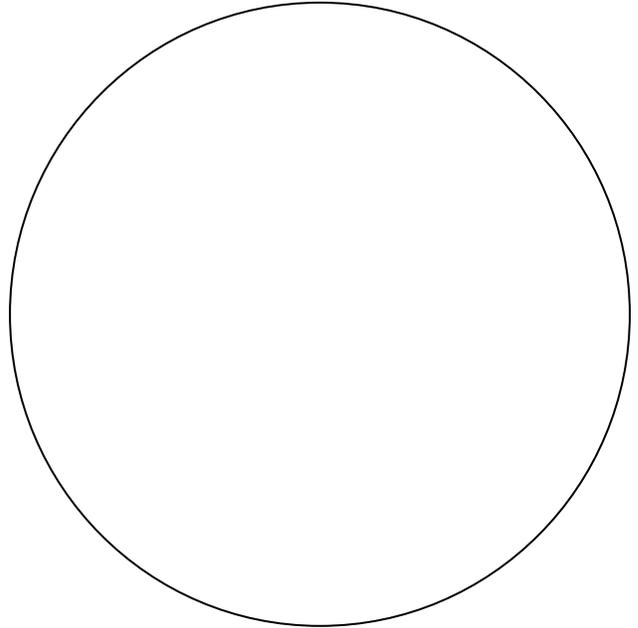
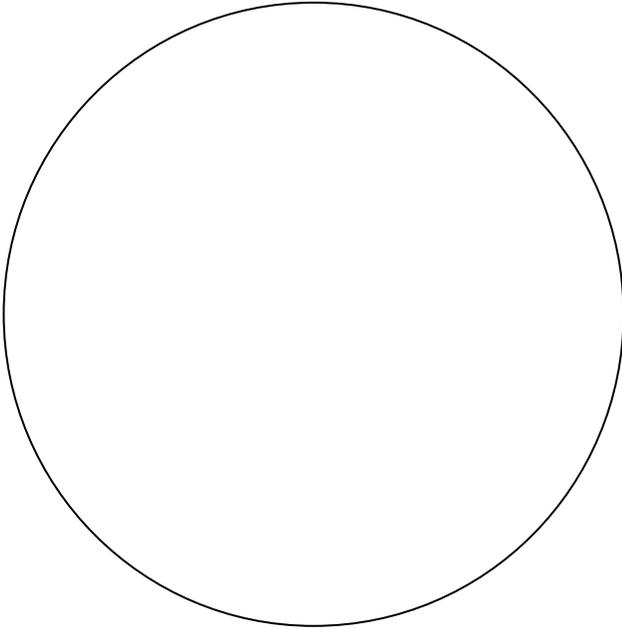
Microscope view Extra inclusion \_\_\_\_\_X



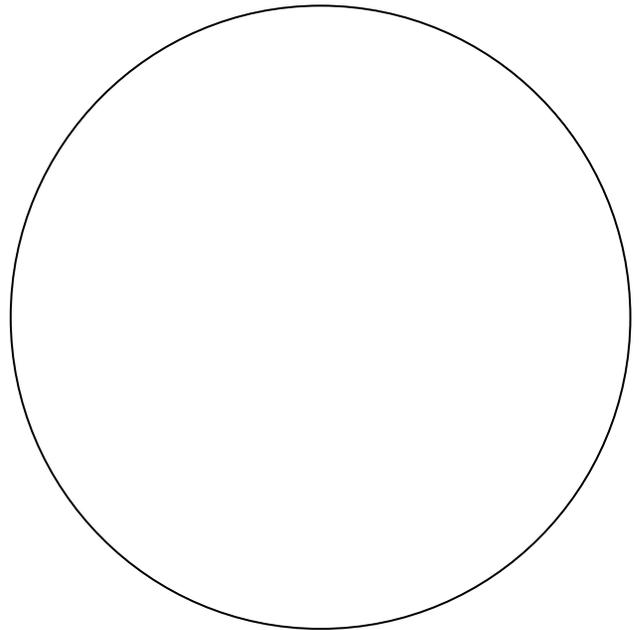
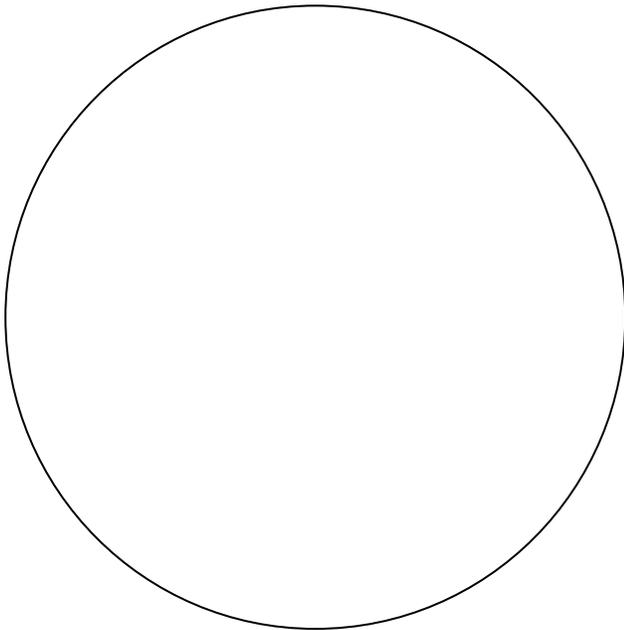
**Draw a flux Chatham Emerald** Give magnification of whole crystal and microscope view (object x ocular magnifications = Total mag.)

Chatham Whole Crystal

Microscope view flux inclusion (P. 197 Read) \_\_\_\_\_X



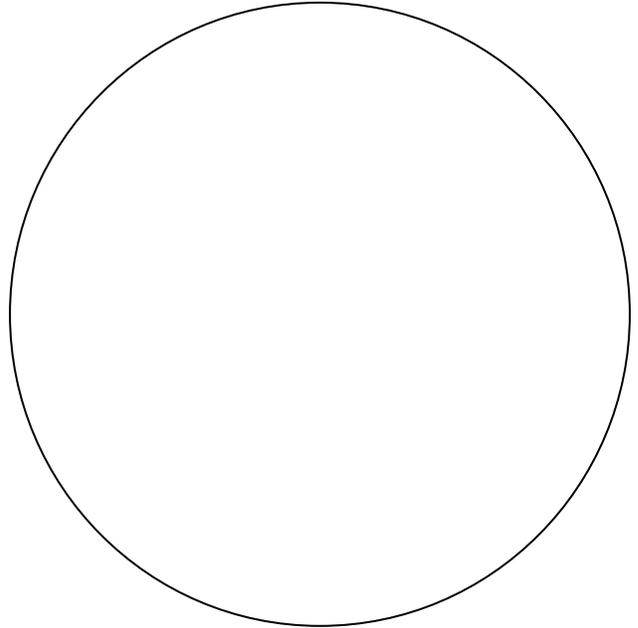
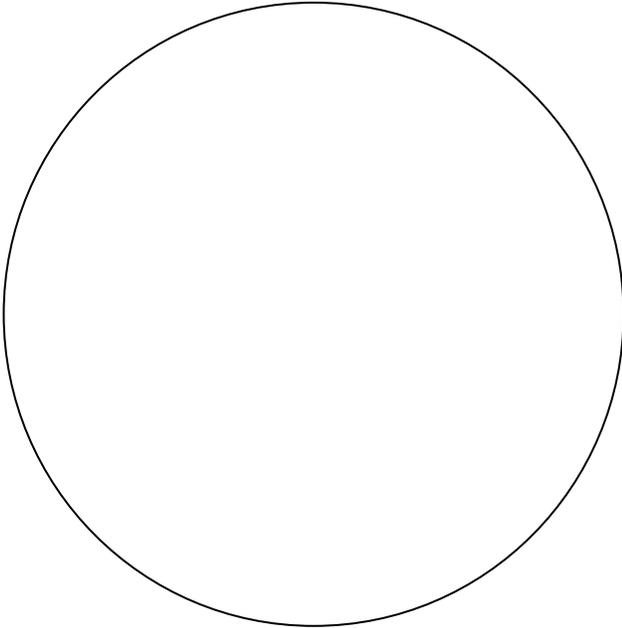
Lechleitner emerald Whole cut stone Microscope Lechleitner Fig 16.9 (P. 197 Read) \_\_\_\_\_X



**Draw a Natural emerald** Give magnification of whole crystal and microscope view  
(object x ocular magnifications = Total mag.)

Sandawan cut stone (p. 195, Fig 16.6)

Microscope tremolite fiber inclusions \_\_\_\_\_X



Whole cut stone

Microscope view fluid inclusions (P. 194, Fig. 16.4) \_\_\_\_\_X

