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American Lunar Society

Lunar Study and Observing Certificate Program

Cosponsored by the Moon Society

This project was designed for those who want to move beyond the simple observing stages.

In completing the Certificate, you will observe not just 'craters and maria', but also sinuous rilles and volcanoes, flooded craters and secondary craters, arcuate rilles and mare ridges. Further, you will come to understand just how these features formed, and what they tell us about the history of the moon. In short, this project will produce competent observers, who are qualified to teach others about the wonders of the moon. May you enjoy the learning and the hunt.

Eric Douglass

To earn the ALS Study and Observing Certificate one must complete the following steps:

1. **Read the the article "Geologic Processes On The Moon"**
2. **Complete an 'open book' test based on this article**
   This is not a difficult test; it is only designed to ensure that the article was read
   Passing score occurs at 80% correct answers.
3. **Observe a list of objects listed below, and keep a log of what was seen.**
   Only 90% of these objects need observed to complete this requirement.
4. Turn in your completed Moon Observing Log to the CFAS Observing Chairman. CFAS

   will submit your Log to the American Lunar Society.

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LOG: List of Objects on the Moon to be Observed

Please include brief descriptions of what you see.
Only 90% of objects (81 of 90) need be observed to meet this requirement.

NOTE: **a lunar atlas is necessary to find the objects in this list**.

So, if you do not have access to one, your first order of business will be to procure one.

I recommend the Rulk atlas (**Atlas of the Moon, by Antonin Rukl**), published by Kalmbach Books, and available from Sky & Telescope Magazine/Online. However, any atlas with moderate detail will work nicely. Alternatively, some 'on line' atlases are found at on the Links Page. The nomenclature will generally follow Rukl, and the ages will follow Wilhelms (The Geologic History of the Moon).

NOTE: **The objects in this list are grouped by basins/lava beds around which they occur.**

NOTE: All **technical terms in this compendium** are found in the article: "Geologic Processes on the Moon", located in the 'General Articles' section of this web site.

The online version of this List allows you to Zip to the areas of the Moon that are currently illuminated and availoable for observation.

http://www.moonsociety.org/Certificate.html

This list is generally arranged from East to West Lunar Longitudes

Mare Crisium Grouping

1. Mare Crisium: a lava filled basin from the Nectarian Period. Multiple rings can be seen to the north, though they are heavily degraded. The innermost ring is covered with lava, and so appears as a mare ridge. The lava was contained by the second ring.

Date:________ Equipment:________ Time:____:____ Zone:______
Description:________

2. Dorsum Oppel: a prominent mare ridge. This was formed by lava covering the innermost ring. The lava later subsided to become the mare ridge.

Date:________ Equipment:________ Time:____:____ Zone:______
Description:________

3. Crater Swift: a good example of a simple crater.

Date:________ Equipment:________ Time:____:____ Zone:______
Description:________

Mare Nectaris Grouping

4. Mare Nectaris: a lava filled basin from the Nectarian Period. Multiple rings can be seen to the south, including the easily recognizable Rupes Altai. Later lava flooding was contained by the inner ring.

Date :__________ Equipment :____________________ Time :___ : ___ Zone :____

Description :____

5. Rupes Altai: the outer ring of the Nectaris Basin.

Date :__________ Equipment :____________________ Time :___ : ___ Zone :____

Description :____

6. Crater Fracastorius: a large crater which demonstrates the geologic history of the region: it transects the Nectaris Basin wall, indicating that it occurred after the Nectaris Basin impact. However, it formed before the lava flooded the region--as the lava forms a continuous sheet in Nectaris and Fracastorius. After the lava solidified, later craters and rilles formed inside Fracastorius.

Date :__________ Equipment :____________________ Time :___ : ___ Zone :____

Description :____

7. Crater Theophilus: a complex crater with multiple central peaks, from the Eratosthenian Period. Along with Fracastorius (above), it demonstrates the geologic history of the region: as its ejecta can be seen on the surface of the lava, it occurred after the basin and after the basin filled with lava.

Date :__________ Equipment :____________________ Time :___ : ___ Zone :____

Description :____

8. Rheita Valley: this trench is traceable for over four hundred kilometers. It represents a 'string' of ejecta from the Nectaris Basin impact.

Date :__________ Equipment :____________________ Time :___ : ___ Zone :____

Description :____

9. Crater Janssen: old crater from the Pre-Nectarian Period, with hummocky material in its northern aspect (ejecta from the Nectaris Basin impact). Note that it has a variety of rilles, including an interesting semicircular rille (? a floor fractured crater).

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

Mare Fecunditatis Region

10. Crater Petavius: a complex, floor fractured crater from the Imbrium Period. One of the floor fractures is easily seen, though the others are a bit more of a challenge.

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

11. Messier and Messier A: a pair of craters that probably formed from a pair of meteors that were gravitationally bound. Note the unusual ejecta pattern.

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

12. Dorsa Geikie: a prominent mare ridge system, over 200 km long.

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

13. Rima Goclenius: prominent set of arcuate rilles. Only seen when close to the terminator.

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

Mare Tranquilitatis Region

14. Rimae Hypatia: excellent example of arcuate rilles. Only seen when close to the terminator.

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

15. Rima Cauchy/Rupes Cauchy: two linear forms, the first a single fault and the second a graben. These were probably caused by the shock wave from the Imbrium Impact and initially covered by ejecta, but later reactivated by other stresses in the surface (perhaps lava loading).

Date :________ Equipment :________ Time :____:____ Zone :____
Description :________

16. Omega Cauchy: prominent lunar dome, only visible when close to the terminator. Another dome (Tau Cauchy) is in the same region.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

17. Lamont: a prominent set of mare ridges with a circular pattern. This probably represents a crater rim which was covered by lava. The ridges formed as the lava subsided.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

18. Arago Alpha/Arago Beta: two lunar domes of moderate size (app. 20 km in diameter). Only visible when close to the terminator.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

Mare Serenitatis Region

19. Mare Serenitatis: a lava filled, multi-ring basin. Mare ridges mark the inner ring. Note the different colors of the lava, as they form a 'target like' pattern. These colors represent different flows with different compositions. The more recent lava flows are more central.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

20. Dorsa Smirnov: a prominent mare ridge which, along with other named mare ridges, is circular in pattern. This represents one of the inner rings of the Serenity Basin which was covered with lava. When the lava subsided, the mare ridges were formed.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

21. Rima Plinius: Excellent set of arcuate rilles.

Date: ____________ Equipment: ________________________ Time: ___:___ Zone: ____

Description: ____

22. Lacus Mortis: ancient lava flooded crater with several rilles (possibly faults laid in the bedrock by the Serenitatis impact, and later reactivated by stresses created by lava loading).

Date :________ Equipment :________________ Time :___:___ Zone :___

Description :______________________________

23. Crater Posidonius: A fascinating example of post crater modification. This crater shows slippage of the entire eastern wall (super-terracing); later lava filling; floor fracturing; and crater impacts.

Date :________ Equipment :________________ Time :___:___ Zone :___

Description :______________________________

Mare Frigoris: Eastern Division

24. Crater Aristoteles: Excellent example of a complex crater from the Eratosthenian Period.

Date :________ Equipment :________________ Time :___:___ Zone :___

Description :______________________________

25. Crater Eudoxus: Good example of a crater from the Copernican Period.

Date :________ Equipment :________________ Time :___:___ Zone :___

Description :______________________________

Highland Region between Mare Nectaris and Mare Nubium

(Note: this is an excellent region to compare craters from different periods)

26. Crater Ptolemaeus: A large old crater from the Pre-Nectarian Period. Its smooth floor was created by the ejecta from the Imbrium impact. The ghost craters inside were produced by the Imbrium impact's ejecta flowing over older craters.

Date :________ Equipment :________________ Time :___:___ Zone :___

Description :______________________________

27. Crater Alphonsus: A large old crater from the Nectarian Period. Its smooth floor and the north-south mottling are from the Imbrium impact's ejecta. It does have a central peak. Several dark halo craters are found in Alphonsus, which are easier to see under high illumination. These probably represent fire fountaining events. These craters are connected by a series of rilles.

28. Crater Arzachel: A complex crater from the Imbrium Period. Has a prominent central rille (see in Photo Gallery).

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

29. Crater Deslandres: Excellent example of a Pre-Nectarian period crater.

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

30. Crater Walter: Old crater from the Nectarian Period. The raised areas, off center, are from the ejecta of the Imbrium impact, and can also be seen in Craters Parbach and Regiomontanus.

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

31. Crater Faraday: Crater from the Imbrium Period, placed here because of its relationships to both earlier (Stofler: Pre-Nectarian) and later (Faraday A and C) craters. These relationships are apparent because of the way the rims overlie each other.

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

32. Crater Hipparchus: Excellent example of a Pre-Nectarian Period crater. Note both the shape of the rim (somewhat squarish), the smooth floor (ejecta from the Imbrium impact), and the linear 'cuts' in the walls (local destruction from the Imbrium ejecta).

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

33. Crater Albategnius: Excellent example of a Nectarian Period crater, which still maintains its central peak.

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

34. Crater Werner: Excellent example of a complex crater from the Eratosthenian Period.

Date:________ Equipment:________ Time:___:___ Zone:____

Description:________

35. Catena Abulfeda: A catena is a crater chain, and this one stretches over 200 km in length. It begins in Crater Abulfeda and continues to the southwest. Crater chains are generally the result of a string of meteorites which are still gravitationally bound. The string results from tidal disruption of a comet, in this case probably by earth (much like Comet Shoemaker-Levy 9, which was disrupted by Jupiter).

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

36. Catena Davy: For origin of a catena, see under 'Catena Abulfeda' above. This one begins 10 km north-east of Crater Davy, and continues in that direction for several tens of kilometers. This difficult object requires steady seeing.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

Sinus Medii Region

37. Rima Ariadaeus: A long graben which is radial to the Imbrium Basin. The original faults were probably caused that basin's formation, with later uplift (? volcanic) causing the faults to open.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

38. Rima Hyginus: A long rille which 'bends' at Crater Hyginus. On high power views, parts of the rille break up into a small chain of craters. This rille is thought to be volcanic in origin, possible representing a chain of collapse pits or pits due to explosive degassing.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

Mare Imbrium Region

39. Mare Imbrium: One of the youngest multi-ring basins, whose lava flooding covered most of the inner rings. The inner rings are marked by mountains peaks and mare ridges.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

40. Sinus Iridium: This crater demonstrates the geologic history of the region. As it transects the wall of the Imbrium Basin, it occurred after that basin formed. However as the lava sheet between the two is smooth, it formed before the lava flooding of this basin.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

41. Mons Recti: This mountain range represents one of the higher points of Imbrium's inner rings. It was of sufficient height that lava flooding failed to cover it. These mountains, along with associated mare ridges, mark the placement of the inner rings.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

42. Mons Pico: See under 41. Mons Recti above.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

43. Mons Piton: See under 41. Mons Recti above.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

44. Dorsum Heim: A prominent mare ridge which marks one of the inner rings of the Imbrium Basin.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

45. Dorsum Grabau: See under 44. Dorsum Heim above.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

46. Apennine Mountains: Part of the main (outer) ring of the Imbrium Basin.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

47. Alpine Mountains: Part of the main (outer) ring of the Imbrium Basin.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

48. Crater W. Bond: An excellent example of the unusual shapes that a crater may take. This occurs because the terminal stages of excavation preferentially occur along existing fault lines. Pre-Nectarian in age.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

49. Rima Hadley: A sinuous rille, famous for being the Apollo 15 landing site. This object is only observable when near the terminator and under good seeing conditions.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

50. Alpine Valley: A huge graben whose faults were originally produced by the Imbrium impact. Later up-doming of the region produced the extension needed for the faults to open. In its center runs a sinuous rille, which can only be seen under excellent conditions in larger telescopes.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

51. Crater Plato: This crater is from the Imbrium Period, and was later filled with lava. Slippage of the wall produced the interesting formation on its western edge. A few small craters in this lava bed make good objects for better nights.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

52. Crater Aristillus: Excellent example of a complex crater from the Copernican Period. Under high illumination, the bright ray pattern can be seen.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

53. Crater Eratosthenes: Excellent example of a complex crater from the Eratosthenian Period.

Date :________ Equipment :________________ Time :____:____ Zone :______

Description :________________________________

54. Mons Gruithuisen: Smooth dome like structure. Has a summit crater, which is a good object for clear nights.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

Oceanus Procellarum: Eastern Division

55. Crater Copernicus: Excellent example of a complex crater from the Copernican Period. Especially to the east, one can identify many prominent secondary craters. The bright ray system can be seen under high illumination.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

56. Crater Kepler: see under 55. Crater Copernicus above.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

57. Crater Hortensius: Excellent example of a simple crater.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

58. Hortensius Domes: Set of lunar domes, only visible when near the terminator. The summit craters are good objects for excellent nights.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

59. Milichius Dome: Prominent lunar dome. Only visible when near the terminator.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

60. Fra Mauro Formation: This is a hummocky patch which begins with Crater Fra Mauro and extends south for over 100 km. It likely represents part of the ejecta from the Imbrium Basin.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

61. Bessarion B: Excellent example of a double meteorite impact. When two impacts occur simultaneously, a septa is raised between the two, as is seen here. To find Bessarion B, find Crater Bessarion, and go 100 km to the west/north-west. This difficult object requires steady seeing.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

Oceanus Procellarum: Western Division

62. Crater Aristarchus: Excellent example of a complex crater from the Copernican Period. The bright ray system can be seen under high illumination.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

63. Aristarchus Plateau: This is the elevated, nearly square chunk of land in which Crater Aristarchus is embedded. It was originally a low section of highland region, but was elevated as a secondary effect of the Imbrium impact. Thus subsequent lava flooding failed to cover it. The surface is smooth and dark due to later lava fountaining on the plateau itself.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

64. Schroter's Valley: A vast, semicircular valley which winds through the Aristarchus Plateau. It begins in an oblong feature called 'The Cobra's Head'. Down the center of Schroter's Valley runs a sinuous rille, which cannot be seen from earth based telescopes. This valley's origin is not well understood, but may represent a vast sinuous rille or a tectonic feature (compare its shape to the rille in Crater Janssen).

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

65. Marius Hills: A large set of lunar domes to the north, south, and west of Crater Marius. These domes lack the smooth appearance of most domes, and may represent differentiated magmism.

Date :__________ Equipment :____________________ Time :____:____ Zone :____

Description :____

66. Rima Marius: One of several sinuous rilles in the Marius Hills region.

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

67. Reiner Gamma: A fascinating, and beautiful, swirl of bright material on the lunar surface. It has a magnetic field associated with it. The exact nature of swirls, and how they continue to remain bright, is open to conjecture. One theory is they they were induced by basins on the opposite side (antipodal) of the moon.

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

68. Crater Letronne: This and the next two craters (below) demonstrate the stages of lava flooding of craters. In some, lava only flooded the interior from below (Billy). In others, lava flooding broke through a wall section to flood the crater (Letronne). In others, lava broke through a wall and nearly covered the rim, leaving only a few peaks and mare ridges to mark the rim (Flamsteed).

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

69. Crater Billy: See under 68. Crater Letronne above.

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

70. Crater Flamsteed: See under 68. Crater Letronne above.

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

Mare Frigoris: Western Division

71. Crater Hershel: Large crater from the Pre-Nectarian period, with a smooth floor from Imbrium's ejecta.

Date :______________ Equipment :______________________________ Time :____:____ Zone :______

Description :____

72. Mons Rumker (Rumker Hills): A compact, volcanic unit having multiple lunar domes.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

Mare Nubium Region

73. Crater Bullialdus: An excellent example of a complex crater from the Eratosthenian Period.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

74. Rima Hesiodus: A long graben, formed by lava subsidence.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

75. Rupes Recta (Straight Wall): A fault created by Imbrium's shock wave, and later activated by lava loading with slippage on its western side.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

76. Rima Birt: A rille that connects two small craters. Its origin is in question, but the author suspects a volcanic origin.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

77. Kies Pi: A prominent lunar dome, some 20 km west of Crater Kies. The summit crater is a good object for steady skies.

Date:__________ Equipment:__________ Time:____:____ Zone:______

Description:__________

Mare Humorum Region

78. Mare Humorum: a multi-ring basin with later lava flooding. The lava covered the inner ring (creating a mare ridge), and is bound mostly by the middle ring. The outer ring is heavily degraded, and is best appreciated in wide angle views.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

79. Mare ridges inside Humorum: these are circular in plan, and mark the inner ring.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

80. Crater Gassendi: a complex crater from the Nectarian Period, filled with an abundance of post-impact changes. These changes include lava flooding and floor fracturing (producing the rilles inside). Some terracing can still be seen along the edges of the crater, whose height exceeded that of the lava flood.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

81. Rimae Hippalus: One of the most spectacular series of grabens on the moon. It tracks along the western side of Humorum. These are arcuate rilles. Note that the rilles run through older craters, but are broken up by the newer ones, and that they cut highland and mare grounds. So a geologic history can be produced for the region.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

82. Rupes Liebig: An impressive fault along the western edge of Mare Humorum.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

83. Crater Mersenius: Ancient crater which is distinctive for having a convex (bowed up) floor. This is probably an intermediate stage for floor fractured craters. The lava plume rose up slowly, deforming the floor but not fracturing it into plates.

Date :__________ Equipment :____________________ Time :___ :___ Zone :___

Description :____

Highland Region South of Maria Nubium and Humorum

84. Crater Tycho: One of the youngest complex craters on the moon. It is from the Copernican Period, and its rays can be traced under high illumination. On excellent nights, secondaries can be seen in the surrounding region (see Photo Gallery)

Date: ________ Equipment: ________ Time: ___:___ Zone: ___

Description: ________

85. Crater Clavius: large ancient crater from the Nectarian Period. It is over 220 km in diameter, and pocked with many later impacts. The smaller one make good objects for steady nights. Note that part of the ejecta can still be seen (see Photo Gallery).

Date: ________ Equipment: ________ Time: ___:___ Zone: ___

Description: ________

86. Crater Moretus: Complex crater from the Eratosthenian Period.

Date: ________ Equipment: ________ Time: ___:___ Zone: ___

Description: ________

87. Crater Schickard: Old crater from the Pre-Nectarian Period, with an elongated shape. To produce an elongated crater, the meteor must come in at an angle of less than 15 degrees to the surface. Any steeper angle produces a circular crater. Most other elongated craters have septa, which indicate impacts from gravitationally bound pairs.

Date: ________ Equipment: ________ Time: ___:___ Zone: ___

Description: ________

88. Crater Schiller: An elongated crater with a complicated history. Wilhelms suggest that it "consists of overlapping elliptical craters that could have been created by oblique, nearly simultaneous impact of a fragmented projectile or by a very low-angle impact..." (The Geologic History of the Moon; D. Wilhelms; USGS Professional Paper 1348).

Date: ________ Equipment: ________ Time: ___:___ Zone: ___

Description: ________

89. Basin Schiller-Zucchius: This is one of the smaller basins on the moon, which consists of two rings. Crater Schiller lies on the outer ring, while Crater Segner lies on the inner ring. The basin is best preserved on its southern and eastern sides.

Date :__________ Equipment :____________________ Time :___:___ Zone :____
Description :____

90. Crater Wargentin: Unusual crater in that the lava which filled it rose to nearly the rim, which is above the surrounding lunar surface. Mare ridges, inside the crater, likely mark the central peaks (where subsidence was the least).

Date :__________ Equipment :____________________ Time :___:___ Zone :____
Description :____