Star-watching Guidebook

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Cooperated with IYA2009 Japan Committee

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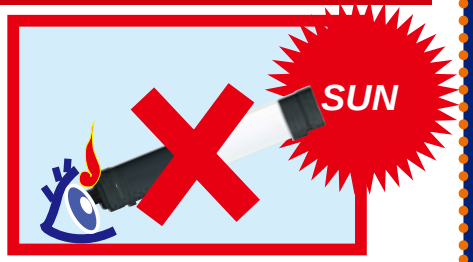
PRECAUTIONS

⚠ Warning!

Never direct the telescope at the Sun! You will be in danger of becoming blind. Never try peering at the Sun through a lens either.



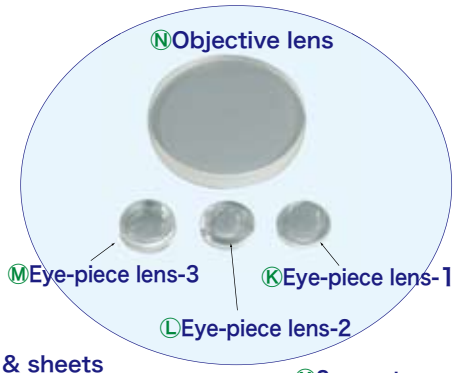
HOSHI no TECHOU

Telescope Assembly

List of components

※Please make sure all listed components are present. Confirm that there are two identical, ring shaped main-tube holders.

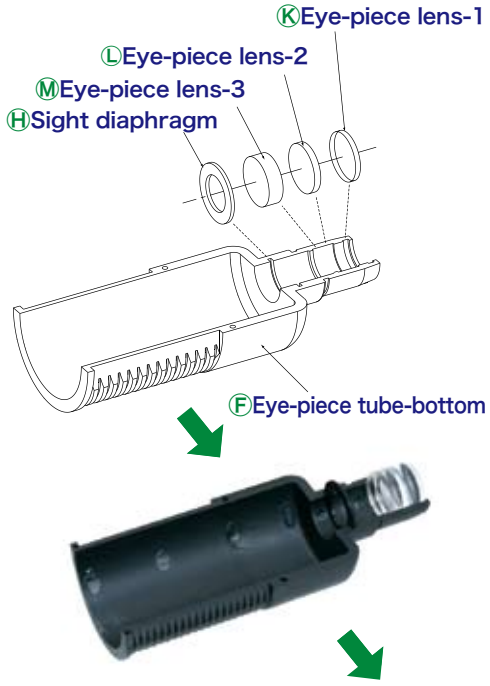
Lenses contained in plastic bag



Tapes & sheets contained in plastic envelope

How to Assemble

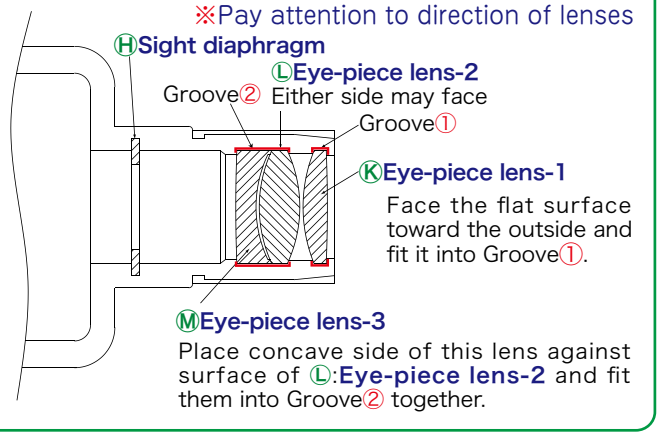
1～6Assemble step by step following the numbered instructions given below.



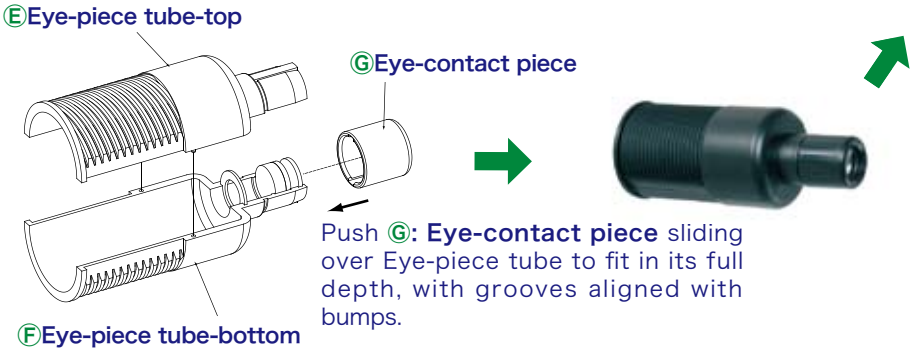
1 Fit Ⓚ:**Eye-piece lens-1**, Ⓛ:**Eye-piece lens-2**, Ⓜ:**Eye-piece lens-3** and Ⓗ:**Sight diaphragm** into Ⓕ:**Eye-piece tube-bottom**. While doing so, please note the directions concerning Ⓚ:**Eye-piece lens-1** and Ⓜ:**Eye-piece lens-3**, so that they are assembled in accordance with the magnified drawing shown below.

Magnified Drawing of Eye-piece lenses

※Pay attention to direction of lenses

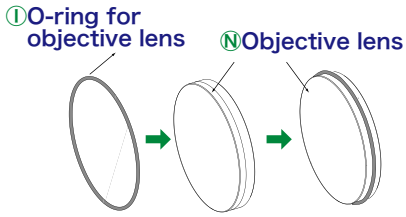


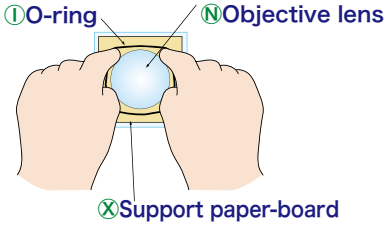
2 Fit Ⓔ:**Eye-piece tube-top** with Ⓕ:**Eye-piece tube-bottom**, by jointing protrusions to holes respectively. Then, fit Ⓖ:**Eye-contact piece** secured onto Eye-lens holder. Now, Eye-piece tube module has been assembled.



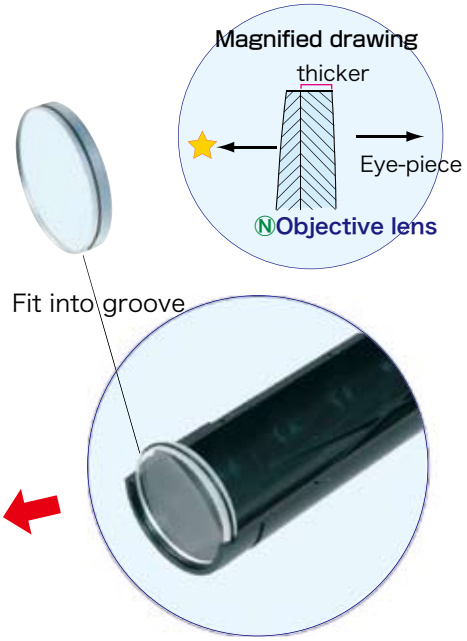
Push Ⓖ: **Eye-contact piece** sliding over Eye-piece tube to fit in its full depth, with grooves aligned with bumps.

3 Fix Ⓘ:**O-ring for objective lens** (black rubber ring) around the rim of Ⓝ: **Objective lens**. Ⓧ:**Support paper-board** will help you fix O-ring. Place Support paper-board on plastic bag, from which Objective lens has been taken. Holding Objective lens inside the hole in the Support paper-board, expand O-ring with fingers of both hands (as shown by drawing) and fit it around rim of Objective lens. After the ring is well fixed, remove Objective lens from the paper-board being careful to keep the lens surface free of finger-prints or scratches.

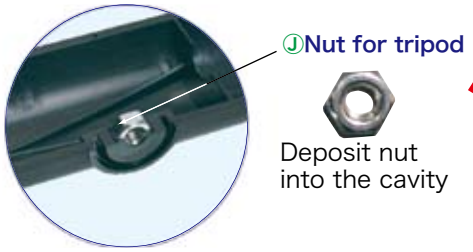




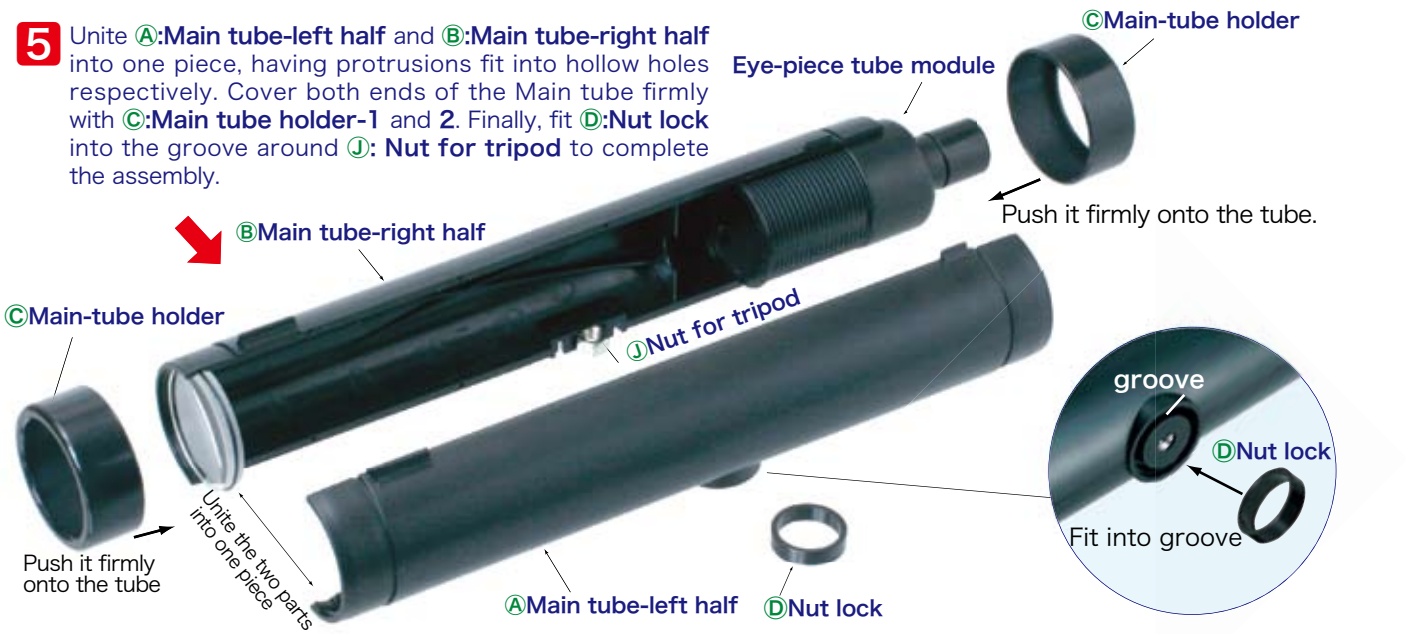
※Attention to the direction of lens



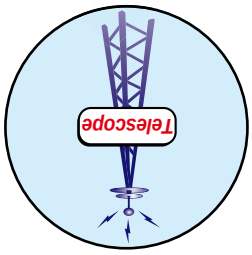
4 Fit Ⓝ:**Objective lens** intoⒷ:**Main tube-left half**, and then, mount the previously assembled Eye-piece tube module letting its screw fit into the casing. Further, place Ⓙ:**Nut for tripod** under-neath the Main tube body.



5 Unite Ⓐ:**Main tube-left half** and Ⓑ:**Main tube-right half** into one piece, having protrusions fit into hollow holes respectively. Cover both ends of the Main tube firmly with Ⓒ:**Main tube holder-1** and **2**. Finally, fit Ⓓ:**Nut lock** into the groove around Ⓙ: **Nut for tripod** to complete the assembly.

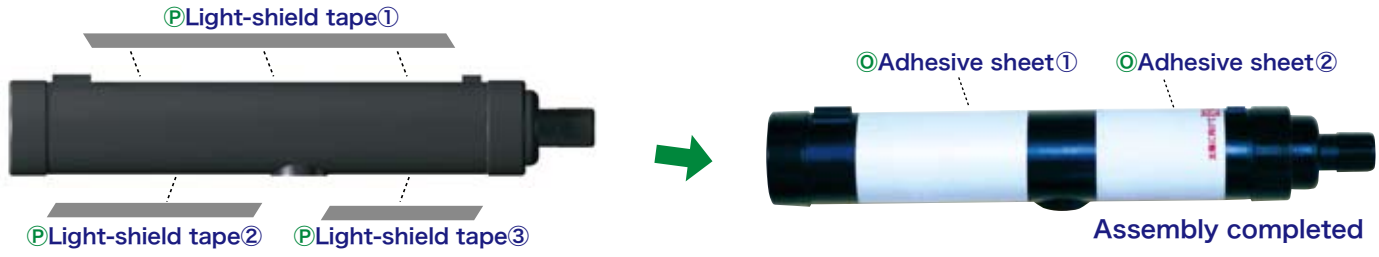


※When completed up to this point, please test the telescope's ability to view distant objects. Adjust eye-piece tube by rotating it, until an inverted image of the object comes into focus. However, if no image comes into focus, either disposition of eye-piece lenses or direction of objective lens must be wrong. In this case, we recommend reassembling the kit from the beginning, carefully consulting the instructions.



Inverted image kept in focus

6 As a last step, stick Ⓟ:**Light-shield tape-**① over the joint-seam line at the top and ② and ③ over the joint-seam line at the bottom, both front and back. Wrap around the main tube with Ⓞ:**Adhesive sheet** ①& ②.



Assembly completed

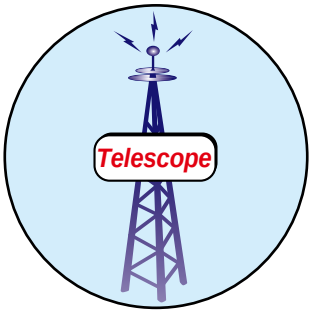
TELESCOPE : Basics and Use

The telescope is said to have been invented about 400 years ago, or in the early 17th Century, in the Netherlands. Being aware of telescopes that could see distant views at magnification, Galileo Galilei, an Italian scientist, observed astronomical objects for the first time in history in 1609, using a telescope he himself fabricated.

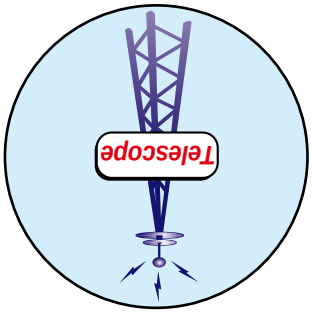
The astronomical telescope you have assembled here is one designed in accordance with the Kepler system, of 15 times magnification, a magnification almost equivalent to Galileo's but which is now significantly superior in performance. With this telescope, you will be able to observe astronomical objects in the same way as Galileo did.

The view you see through the telescope is called the image, which appears inverted, upside-down and left-to-right. While this may seem a little inconvenient, the universe has neither top nor bottom and, therefore, the inverted image is quite acceptable as it is for the purpose.

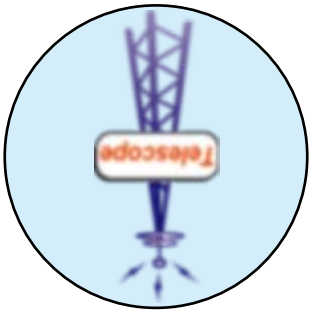
The magnifying power of this astronomical telescope is 15. This means that you can see an object across a given distance, as if you were seeing it from a point as close as 1/15th the distance. However, 15 times magnification, also brings with it 15 times as much magnified blurring or shaking of the image in the scope. Therefore, when you look at an astronomical object using hand-held telescope, the object is easily shaken out of sight and lost from the scope. Such being the case, it is important that you hold yourself steady by sitting on chair or leaning on a wall or tree, when you use the telescope. Otherwise, the most effective method is to set the telescope on a tripod. The astronomical telescope that you have assembled now is provided with a screwed nut for a tripod, which is embedded in the bottom of the main tube. When you set the telescope onto even a small tripod and look through it without touching it with your hands, then you can see a very stable image of the object.



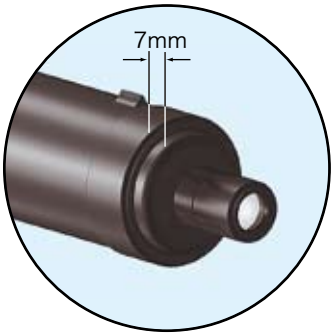
Erect image
(by naked-eye)



Inverted image
(by astronomical telescope)

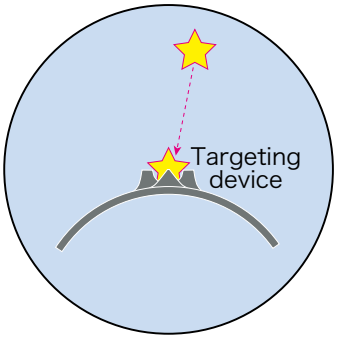


Out-of-focus image



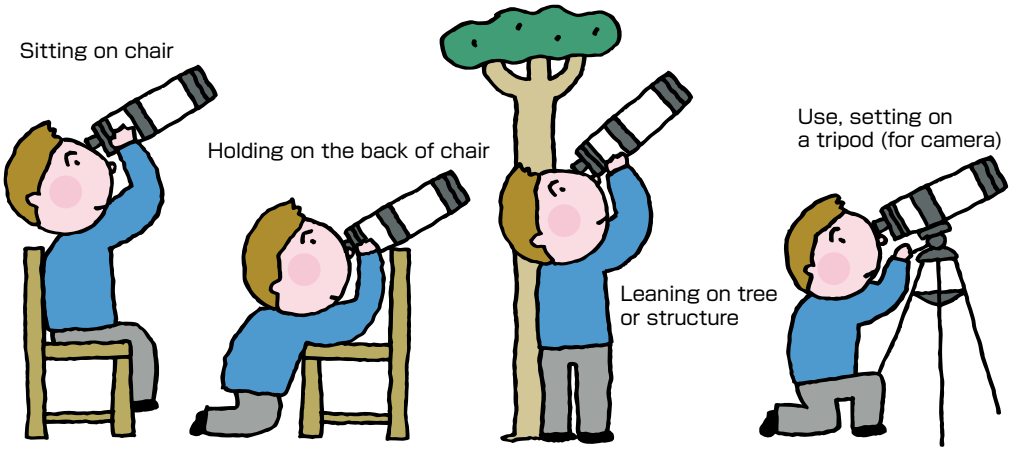
▲ Focusing

Prior to using the telescope for astronomical observation, it should be adjusted to focus properly. Focus by rotating the eye-piece tube module to adjust. For a person with normal eye-sight, the astronomical focusing will be best, when the eye-piece tube protrudes from the main tube end by approximately 7 millimeters at its shoulder. (See the drawing.) If the eye-piece tube module protrudes further, it will focus on a less distant object.



▲ Sighting a specific astronomical object

First, aim at an astronomical object by naked eye with the targeting device which sticks out on top of the main tube as shown in the drawing. While holding the telescope steady, slowly shift the observing eye to the eye-piece tube. Now, you will see the aimed-for object in sight.

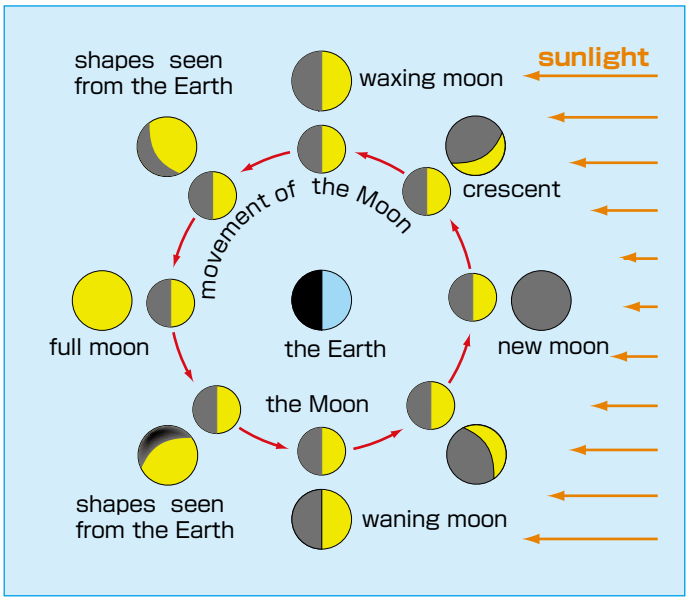


Observation of the Moon

The most familiar astronomical object to us will be the Moon, which orbits around the Earth. The Moon's glow is reflected sunlight. Its brightness is as much as –13 degrees of luminance, which is bright enough to read a book by moonlight. The Moon is 3,476 kilometers in diameter or nearly one-quarter the diameter of the Earth, and its distance from the Earth is approximately 380,000 kilometers on average. The figures on the Moon's surface is visible even with the naked eye. The area that appears dark is called the sea or Lunar mare. But there exists no water like there does on the Earth. Using an astronomical telescope, you may look at various lunar features such as craters, which look like holes on the surface, or ranges of mountains and valleys.

The Moon is an astronomical object that waxes and wanes. Along the waning edge is an area that provides a particular advantage for observation, where the sunlight comes from an angle, allowing the uneven lunar surface to appear clearly in a stereoscopic image.

The Moon takes about a month to orbit the Earth. The positional relationship of the Moon–Earth–Sun varies every day. When the Moon comes in the same direction from the Earth to the Sun, it is a new moon, that is, the lunar age being zero. The lunar age increases by one day, every day. About half a month following the new moon, it will be a full moon with the lunar age reaching 15.



▲How does the Moon look?
When the Moon comes in the same direction to the Sun from the Earth, we say it is a "new moon". At the time of the new moon, the Earth faces the dark side of the Moon which does not reflect the sunlight. So, the new moon is invisible. The period from a new moon to the next new moon is approximately one month. In the case of the Moon, the cycle of its rotation is equal to cycle of its revolution going around the Earth. Therefore, we are always looking at the same side of moon.

▶ Photo of the Moon at the lunar age 8, taken by Kunihiko Kawamoto in Hofu City, Yamaguchi Pref. (Nikon Coolpix 775)

▲When the lunar age is approx.3, the Moon appears in the western sky after sunset.

▲When the lunar age is approx.7, the Moon appears in the southern sky after sunset and goes down at midnight.

▲When the lunar age is approx. 15, it is full moon and will reach the highest point of the sky at midnight.

▲ When the lunar age is approx. 21, the Moon appears at midnight and keeps rising until it reaches southern sky around the time of sunrise.

▲ When the lunar age is approx. 28, the Moon appears in the eastern sky before sunrise.

Moon Map

Sea・Lake・Bay

A Mare Crisium (Sea of Crises)
B Mare Fecunditatis (Sea of Fecundity)
C Mare Nectaris (Sea of Nectar)
D Mare Tranquillitatis (Sea of Tranquillity)
E Mare Serenitatis (Sea of Serenity)
F Mare Imbrium (Sea of Rains)
G Lake of Dreams
H Oceanus Procellarum (Ocean of Storms)
I Mare Nubium (Sea of Clouds)
J Mare Humorum (Sea of Moisture)
K Bay of the center
L Mare Vaporum (Sea of Vapors)
M Sea of Cold
N Sinus Iridum (Bay of Rainbows)
O Seething Bay

Mountains・Valleys

a Vallis Rheita
b Rupe Altai
c Montes Pyrenaeus
d Montes Taurus
e Rima hyginus
f Montes Haemus
g Caucasus Mountains
h Montes Alps
i Montes Apenninus
j Montes Carpathian
k Rupes Recta
l Montes Riphaeus
m Alpine Valley

Craters

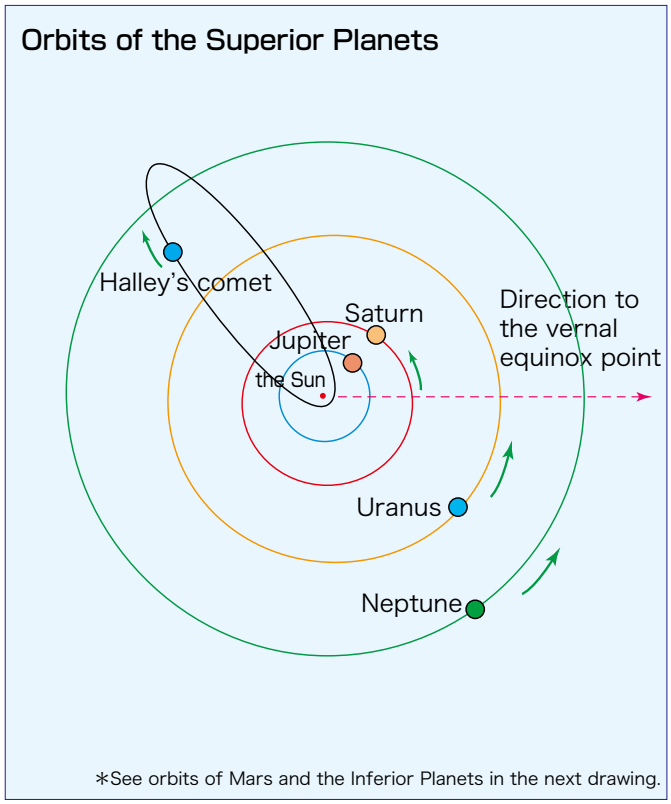
1 Petavius
2 Langrenus
3 Macrobius
4 Fracastorius
5 Catharina
6 Cyrillus
7 Theophilus
8 Posidonius
9 Plinius
10 Manilius
11 Delambre
12 Maurolycus
13 Clavius
14 Maginus
15 Tycho
16 Stofker
17 Aliacensis
18 Werner
19 Walter
20 Regiomontanus
21 Purbach
22 Davy
23 Arzachel
24 Alphonsus
25 Ptolemaeus
26 Herschel
27 archimedes
28 Autolycus
29 Aristillus
30 Cassini
31 Plato
32 Timocharis
33 Eratosthenês
34 Copernicus
35 Kepler
36 Aristarchus
37 Grimaldi

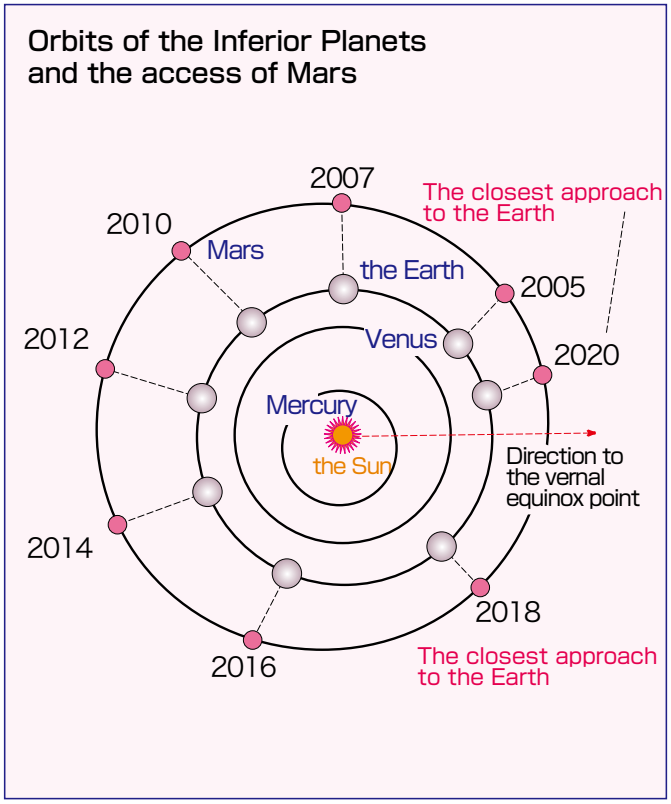
Illustrated by KAGAYA

Observation of Planets

In the starry space, there are other planets like the Earth which are going around the Sun. These planets glow reflecting the sunlight. We know of the existence of 8 planets of the Sun, consisting of Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune, named in the order of their orbits from the Sun.

Observing such planets every night, you will find that those planets are rambling across the constellations. This is because the Earth and other planets are moving along their own orbits around the Sun, and as a result, their positional relationships are also varying. Five planets are visible to the naked eye: Mercury, Venus, Mars, Jupiter and Saturn. Using the astronomical telescope that you have assembled, you will be able to see how Venus waxes or wanes in its appearance and also to see four satellites of Jupiter orbiting around it. These satellites are called Galilean moons because they were discovered by Galileo. You will also be able to see the rings of Saturn.





▲ Venus
Venus is called the Evening Star or Morning Star, too. It brightly glows in the western sky after sunset and as well in the eastern sky before sunrise. You can see how it waxes or wanes, with the astronomical telescope that you have assembled. Be careful not to follow it in the direction of the sun, since its direction is near the Sun's.

▲ Mars
Mars travels along an orbit immediate outside the Earth's. Mars glows orange approaching the Earth every two years and two months. With a larger telescope, you can observe a pattern over its surface. How it approaches the Earth is illustrated in the drawing, above right.

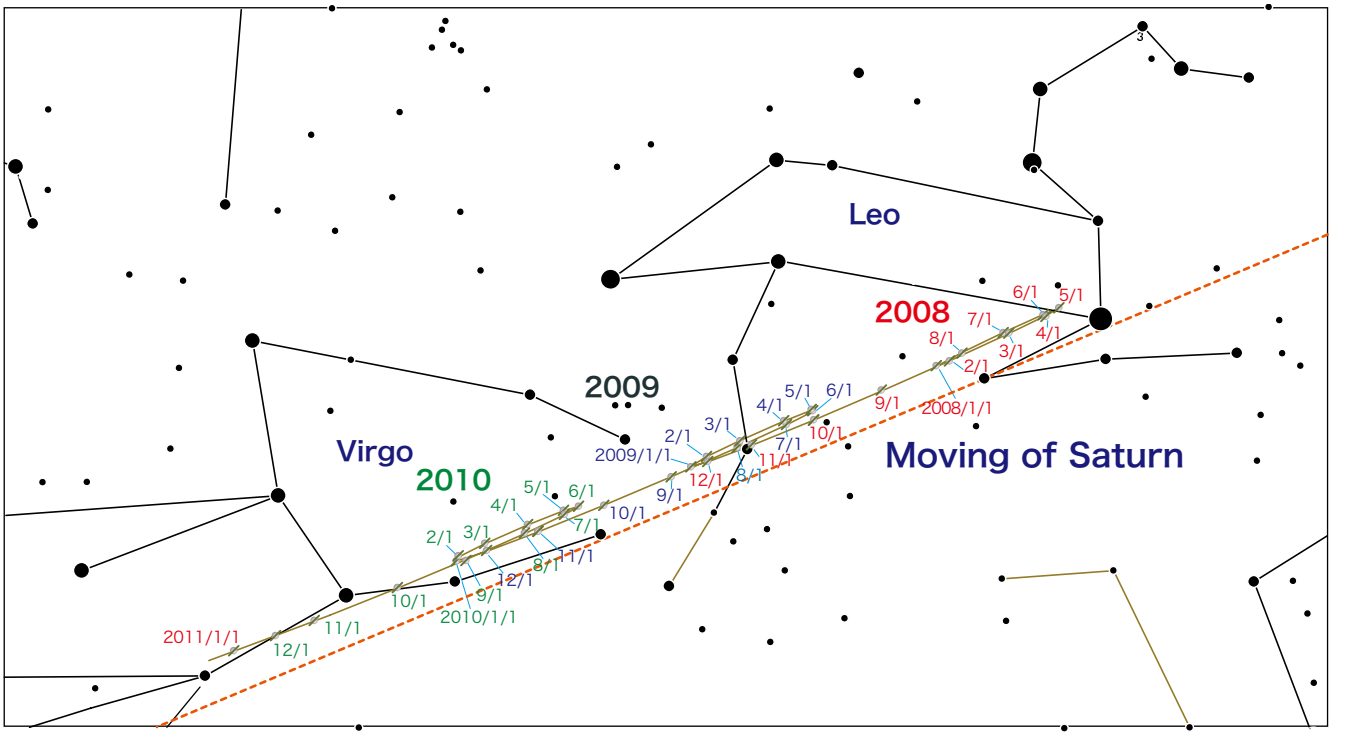
▲ Satellites of Jupiter
The four satellites of Jupiter, which are called Galilean moons, can be viewed by the telescope you have assembled. Those satellites, from innermost to outermost, are called, Io, Europa, Ganymede and Callisto, and are going to change their relative positions as time goes on.

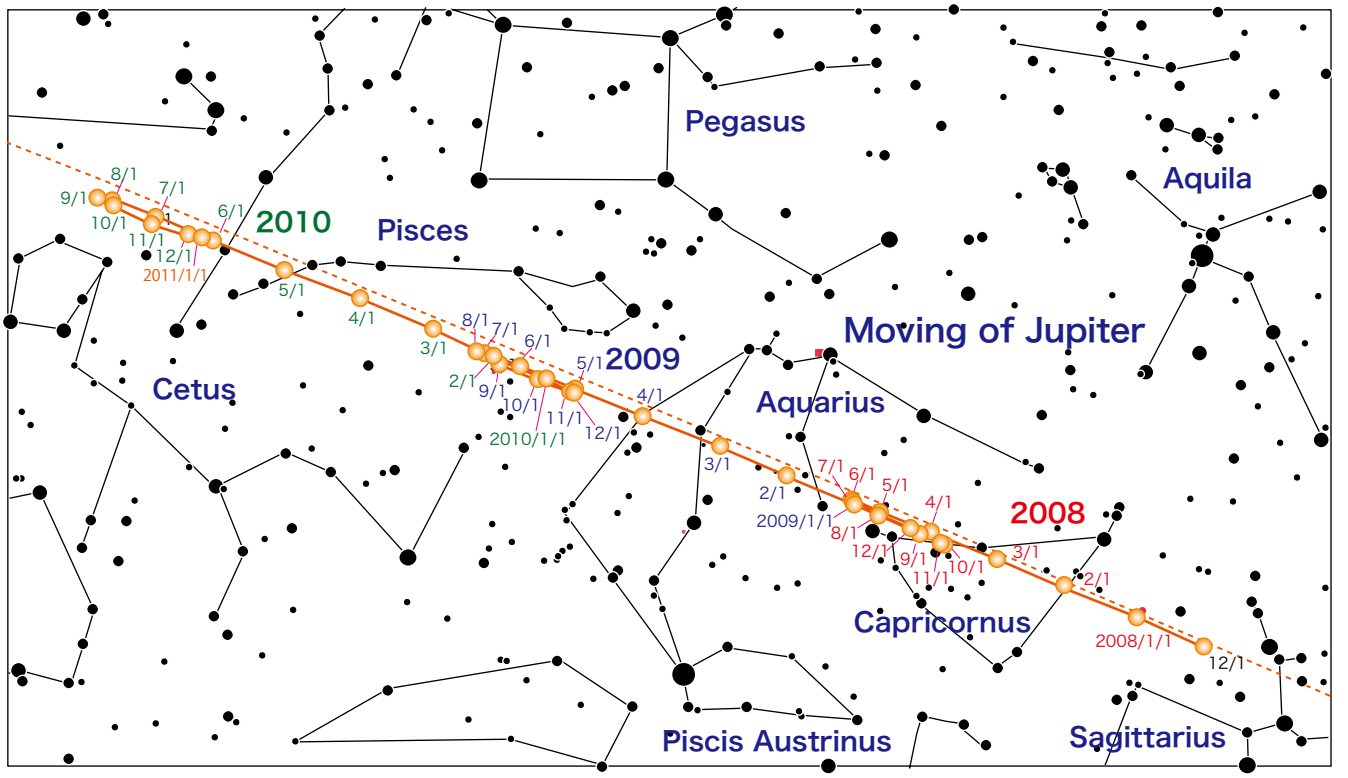
▲ Jupiter
Jupiter is the largest planet within the Solar System and appears to have stripes over its surface. We can see the shape of Jupiter is like a vertically deflated globe. However, the Great Red Spot or such details cannot be seen without a larger telescope.

Mars		Jupiter		Saturn	
Month to approach the Earth	Constellations	Month in opposition	Constellations	Month in opposition	Constellations
2007 Dec.	Gemini	2007 Jun.	Ophiuchus	2007 Feb.	Leo
2010 Jan.	Cancer	2008 July	Sagittarius	2008 Feb.	Leo
2012 Mar.	Leo	2009 Aug.	Capricornus	2009 Mar.	Leo
2014 Apr.	Virgo	2010 Sep.	Pisces	2010 Mar.	Virgo
2016 May	Libra	2011 Oct.	Aries	2011 Apr.	Virgo
2018 July	Capricornus	2012 Dec.	Taurus	2012 Apr.	Virgo

▲ The best time to see those planets which travel along orbits outside the Earth's (superior planets) is when they come in an opposite direction from the Earth to the Sun, that is, in opposite each other. Mars, going along its own orbit, approaches the Earth every 2 years and 2 months.

▲ Saturn
Saturn is a beautiful planet known for its rings. The rings will be visible even with the telescope you have assembled, but you will need a larger telescope for observing it in more detail.



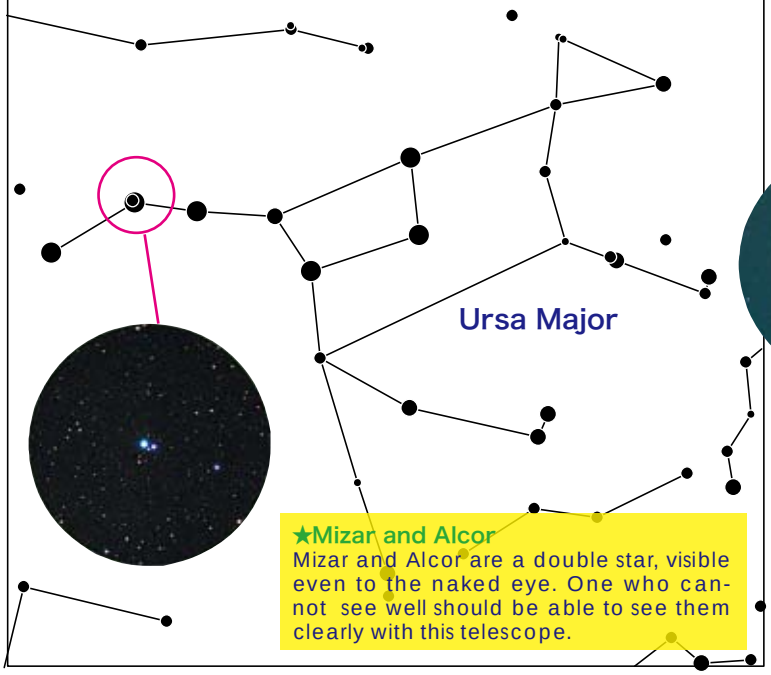


Let's look at various astronomical objects.

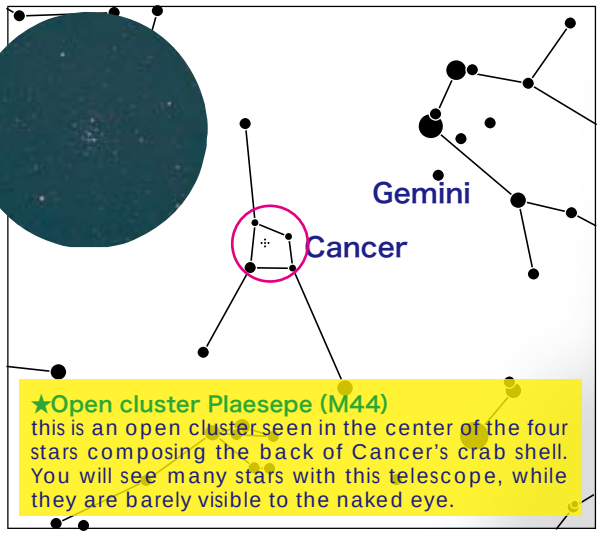
There are numerous, various astronomical objects in the starry sky. Using a telescope, you will be able to view such objects in more details than with the naked eye. Some of the astronomical objects you should see at will be introduced below.

★ Let's try looking at The Milky Way.
While it looks like a belt of faint, milky light to the naked eye, you will see through the telescope an aggregation of innumerable stars.

The best to look at during April-June

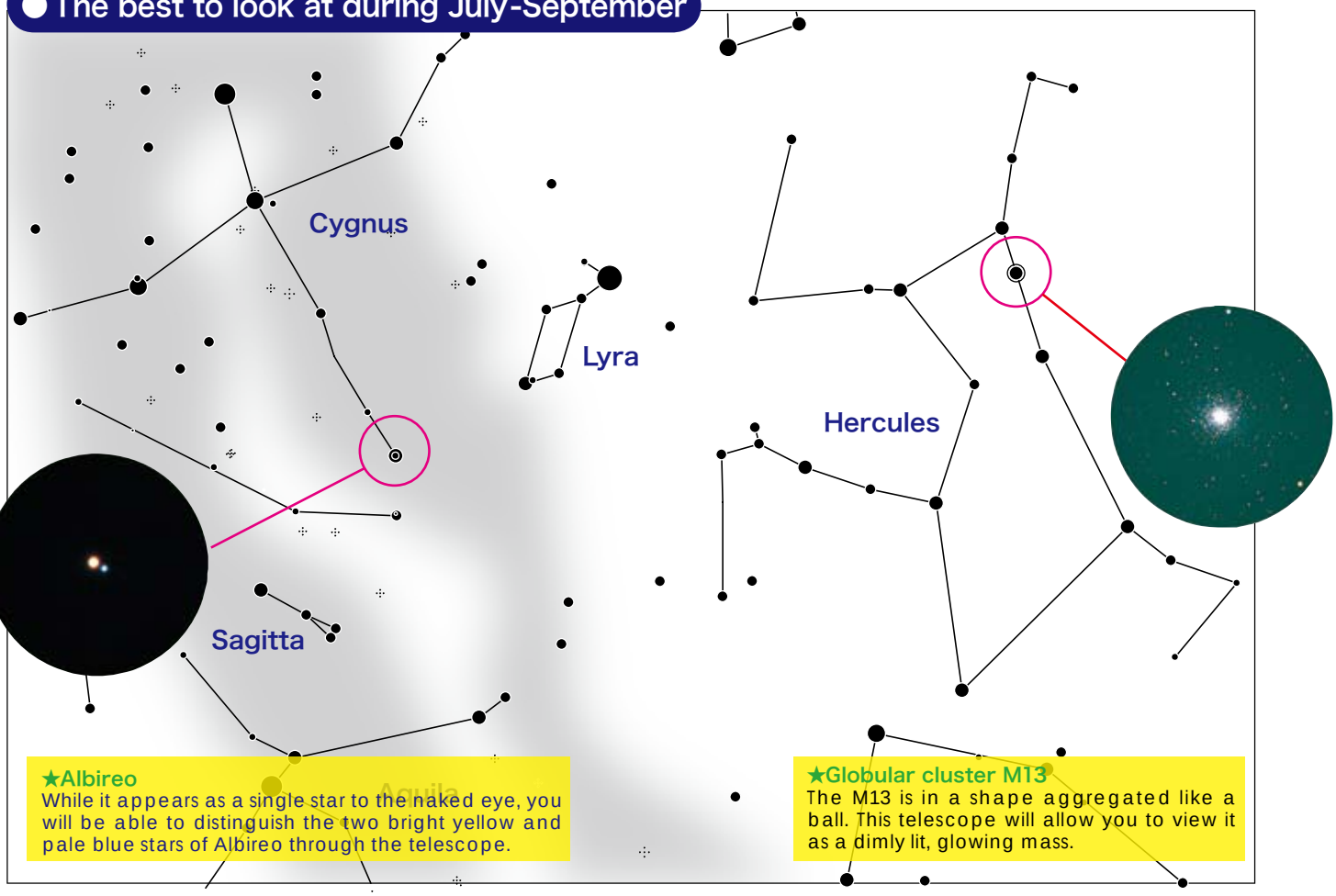


★Mizar and Alcor
Mizar and Alcor are a double star, visible even to the naked eye. One who cannot see well should be able to see them clearly with this telescope.



★Open cluster Plaesepe (M44)
this is an open cluster seen in the center of the four stars composing the back of Cancer's crab shell. You will see many stars with this telescope, while they are barely visible to the naked eye.

The best to look at during July-September

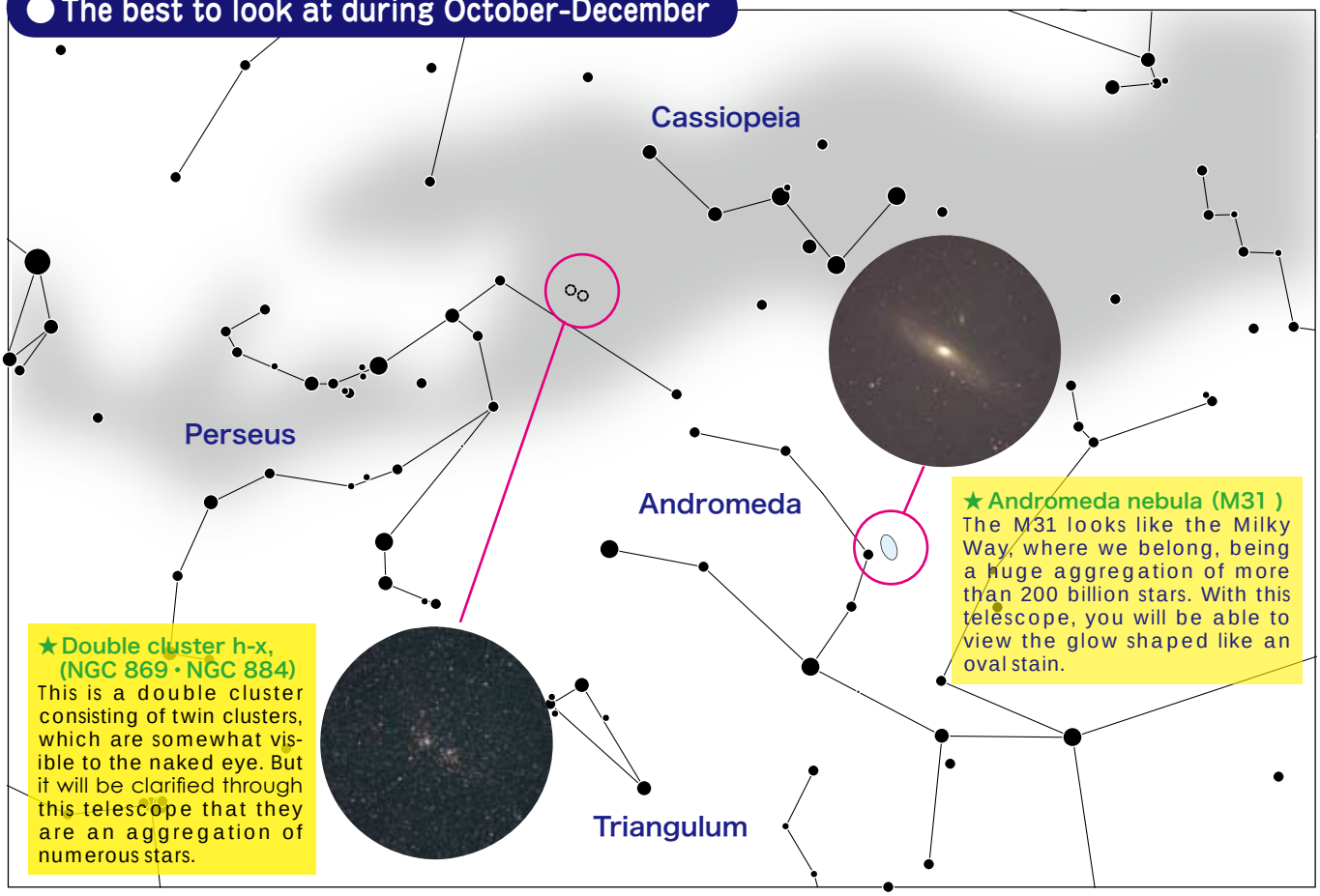


★Albireo
While it appears as a single star to the naked eye, you will be able to distinguish the two bright yellow and pale blue stars of Albireo through the telescope.

★Globular cluster M13
The M13 is in a shape aggregated like a ball. This telescope will allow you to view it as a dimly lit, glowing mass.

Let's look at various astronomical objects.

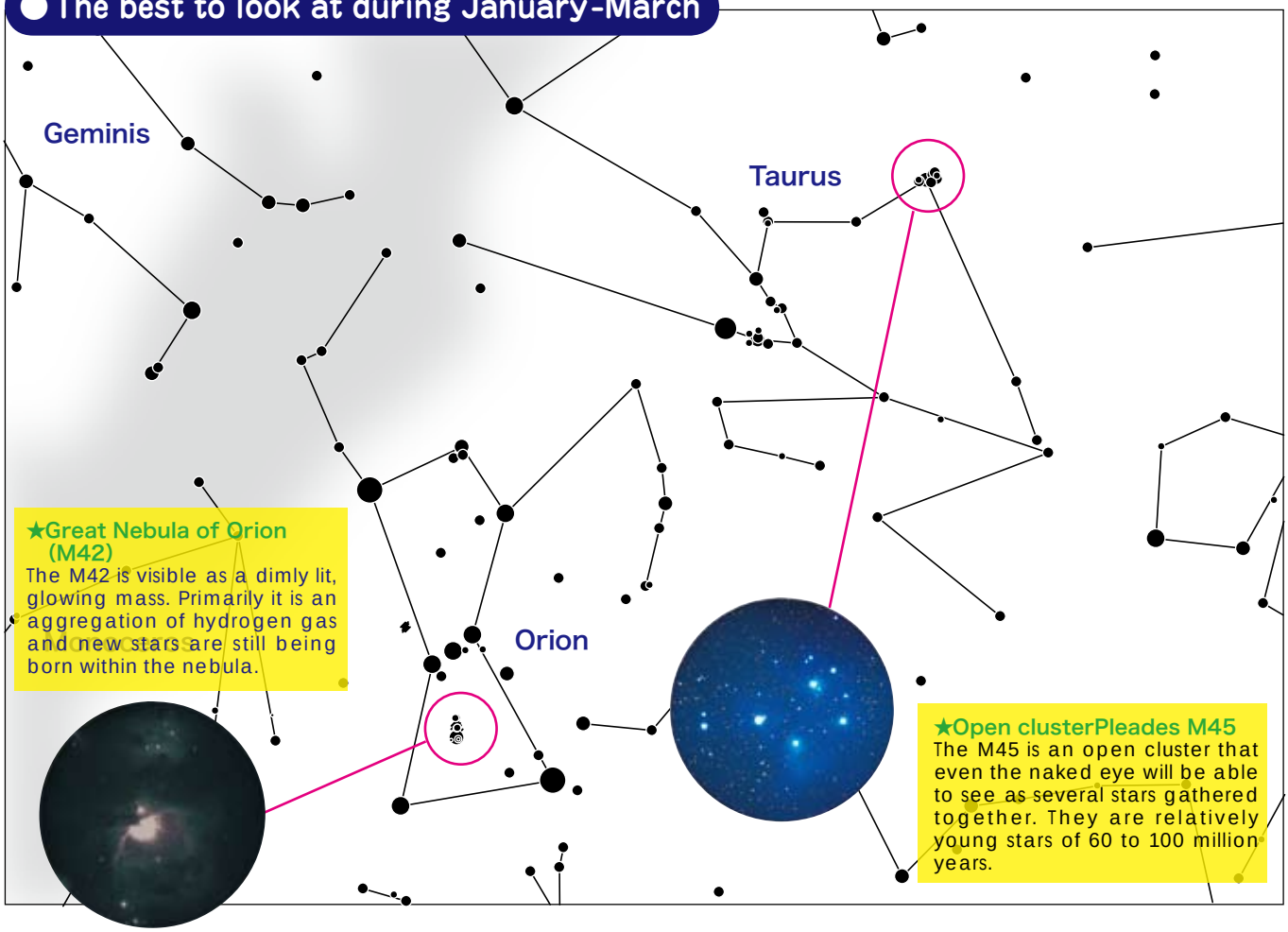
The best to look at during October-December



★Andromeda nebula (M31)
The M31 looks like the Milky Way, where we belong, being a huge aggregation of more than 200 billion stars. With this telescope, you will be able to view the glow shaped like an oval stain.

★Double cluster h-x, (NGC 869・NGC 884)
This is a double cluster consisting of twin clusters, which are somewhat visible to the naked eye. But it will be clarified through this telescope that they are an aggregation of numerous stars.

The best to look at during January-March



★Great Nebula of Orion (M42)
The M42 is visible as a dimly lit, glowing mass. Primarily it is an aggregation of hydrogen gas and new stars are still being born within the nebula.

★Open clusterPleades M45
The M45 is an open cluster that even the naked eye will be able to see as several stars gathered together. They are relatively young stars of 60 to 100 million years.

What is International Year of Astronomy?

▲ Galileo Galilei (1564～1642)
(Illustrated: Tetsuya Takabe)

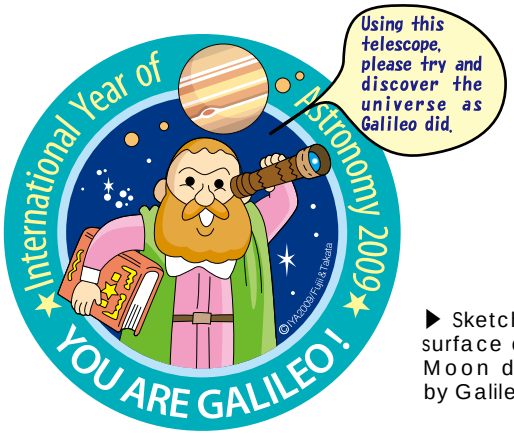
The year 2009 is the 400th year since 1609 when Galileo Galilei, an Italian scientist, opened a door to the universe for the first time using an astronomical telescope. UNESCO, or the United Nations Educational, Scientific and Cultural Organization, has designated the year 2009 as International Year of Astronomy (IYA in abbreviation), accordingly.

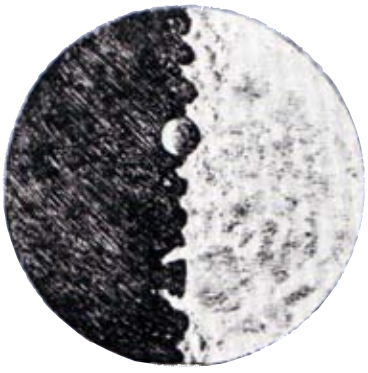
Across the world, people will look up at the starry night sky, contemplating the existence of the Earth and human beings living, in the universe, and discover whatever they can. That is aim of the International Year of Astronomy.

The Maxim for this year will be "THE UNIVERSE; YOURS TO DISCOVER"

Galileo made many important discoveries in the fields of physics and astronomy. In particular, he performed significant scientific research, directing his telescope toward the starry sky and observing various astronomical objects.

He built many telescopes of different magnifications. Beginning from 1609, he observed the Moon, the Sun, planets of the solar system including Venus, Jupiter and Saturn, star clusters or nebulae, the Milky Way and other phenomena, in successfully solving enigmas of the universe, one after another. Above all, he discovered, through observation of Jupiter and Venus, the proof for the heliocentric theory that concluded that the Earth like other planets orbited around the Sun which was positioned at the center of the solar system, on idea that aroused a tremendous sensation at the time.





▶ Sketch of a surface of the Moon drawn by Galileo.

▲ Telescope made by Galileo Galilei.
(Illustrated: Tetsuya Takabe)

⚠ Warning !

Never look at the Sun through a telescope, because you could critically damage or lose your eyesight !!!

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