

2 Early Autumn Constellations

Although autumn has already begun, the shorter days bring darkness earlier and the prolong the period during which we can see the constellations of summer. So before covering the fall constellations, we'll first review the constellations of summer which are still visible during the first hour or two after sunset.

2.1 First Star I See Tonight...?

As the sky starts to darken, the first few stars will begin to appear. But the first ones will really appear long before you would really call the sky dark. The three brightest stars visible in the night sky this time of year are named Altair, Deneb, and Vega. But before we can talk about where in the sky they are, first we have to learn a little about how to give directions in the sky.

2.2 How Far Apart: Working the Angles

When astronomers measure positions on the night sky, they use a coordinate system just like you find on maps of the earth which use latitude and longitude. Most of us use miles (or kilometers) to measure the separation between places on earth, but this won't work for the sky. Instead, we must use angles.

You're probably used to thinking of angles as those itty-bitty marks on a protractor. While they are, they are *not* the distances between those marks. On your typical 6-inch diameter protractor, 1° is a bit more than 1 mm (1.33 mm) at the edge of the protractor. But if you had a 1-meter diameter protractor, 1° would be nearly 1cm (8.7 mm, about 1/3-inch). The "itty-bitty" part of the impression starts to fade.

At their heart, angles are ratios: the ratio of a size to a distance. So that 1 mm length at 10 cm is the same as the 10 mm at 1-meter. And it's (close to) the same as 2-full moon diameters (7000 km) at the distance of the moon (385,000 km).

Okay, so what, you're thinking...do I have to hold a protractor up to my eye to find things? No....

2.2.1 The Human Protractor

Assuming you have at least one good eye and one arm and hand, you already have everything you need to approximate positions on the sky.

- Stretch out your arm and spread your fingers open wide: the angle covered from the tip of your pinky to the tip of your thumb is about 20° .
- Now make a fist, again with your arm stretched out: the angle covered by your first (keep your thumb tucked under) is about 10° .
- Hold up three fingers, your pinky, ring finger, and middle finger: they cover about 5° .
- Hold up two fingers: your index and middle finger. They cover about 3° .
- Keep that arm up! Stick up your thumb: it covers about 2° .
- One more...stick up your pinky finger: it covers about 1° or about 2-times the

apparent size of the moon.

Try this: the next time there is a full moon, hold up your pinky at arm's length. Which is bigger? That is, can you cover the moon with your little finger (try with only one eye open)? What about near moonrise (evening) or moonset (morning) when the moon is near the horizon and seems so big; can you cover it then?

2.2.2 North to Alaska...Uhm, Manhattan

Yes, from here in Bay Ridge, Brooklyn, north is more-or-less toward Manhattan. On the one hand, it's easy to find north by looking for that glow from the city. Or maybe not if you're having trouble figuring out which part of the glow is from Manhattan... It's pretty hard to see much in the sky, even in directions other than the north. But, with north approximately determined, where are the fun things?

2.3 What's Up?

2.3.1 Planets!

Here's a trick question: how many planets are you able to see on any night of the year? Think, think, think.... The answer is *at least* one! That one is, of course, Earth. But right now, in the fall of 2008, you can also see Jupiter early in the evening, as soon as it gets even a little dark. Jupiter will be the first "star" you see in the evening, somewhat low in the south, to south-west. Once it gets dark, it will be the brightest thing in the night sky (well, except for airplanes on approach to La Guardia).

If you have binoculars, have a look at Jupiter with them. Do you see it accompanied by some rather bright stars? Jupiter has four large bright moons (it has well over 60 "moons," many of them small and most invisible from Earth even with a large telescope). These four bright moons were first discovered by Galileo Galilei in January of 1610 and are collectively called the Galilean moons in honor of his discovery.

UNESCO (United Nations Educational, Scientific and Cultural Organisation) has declared 2009 the International Year of Astronomy in part to honor the 400th anniversary of Galileo's "invention" of the telescope. Galileo did not actually invent the telescope. But it does appear that the first definite use of one was in early 1609. Later that year, Galileo built modified telescopes with slightly better magnification (up to 20X) and used them to make sketches of the surface of the moon and later to view Jupiter.

2.3.2 Summer Triangle – Lyra, Cygnus, Aquila

While summer is a fading memory, it's not too late yet to still see the major constellations of summer. Because of how the daylight hours are shortening, the summer constellations remain on display for a little longer. Three of the brightest stars of the summer appear high overhead on summer nights, each in a different constellation. They form an approximate isosceles triangle. If you have a planisphere, you can turn it to the current day and time in mid-October to find these.

If you don't have a planisphere, have a look at .

In mid-October, try looking for them at about 7:30 pm. Go outside, find a place where you can look straight up without being blinded by nearby street lights. The point straight up over your head is called the *zenith*. As the earth rotates, what objects pass directly overhead, through the zenith, will change. In mid-October in the early evening, near the zenith, but not quite directly overhead will be Deneb (deh-neb). Deneb is the faintest of the three, but still quite bright. About 25° to the east will be Vega (vee-gah), the brightest of the three. And about 35° south of both of them will be Altair (awl-tear). Once you've found these three, we're going to use them to find our way around the sky tonight.

The name Deneb originates from Arabic and means “the tail.” Deneb is the tail of Cygnus (sig-nus), the celestial swan. This constellation is sometimes also called The Northern Cross because the 5-6 brightest stars form a cross. These brightest 5-6 stars should all be visible from here in Brooklyn.

Vega is the brightest of the stars this time of year. But the other stars in this constellation can be a challenge to see from the city. And the constellation, Lyra (lie-rah) is much more compact than Cygnus.

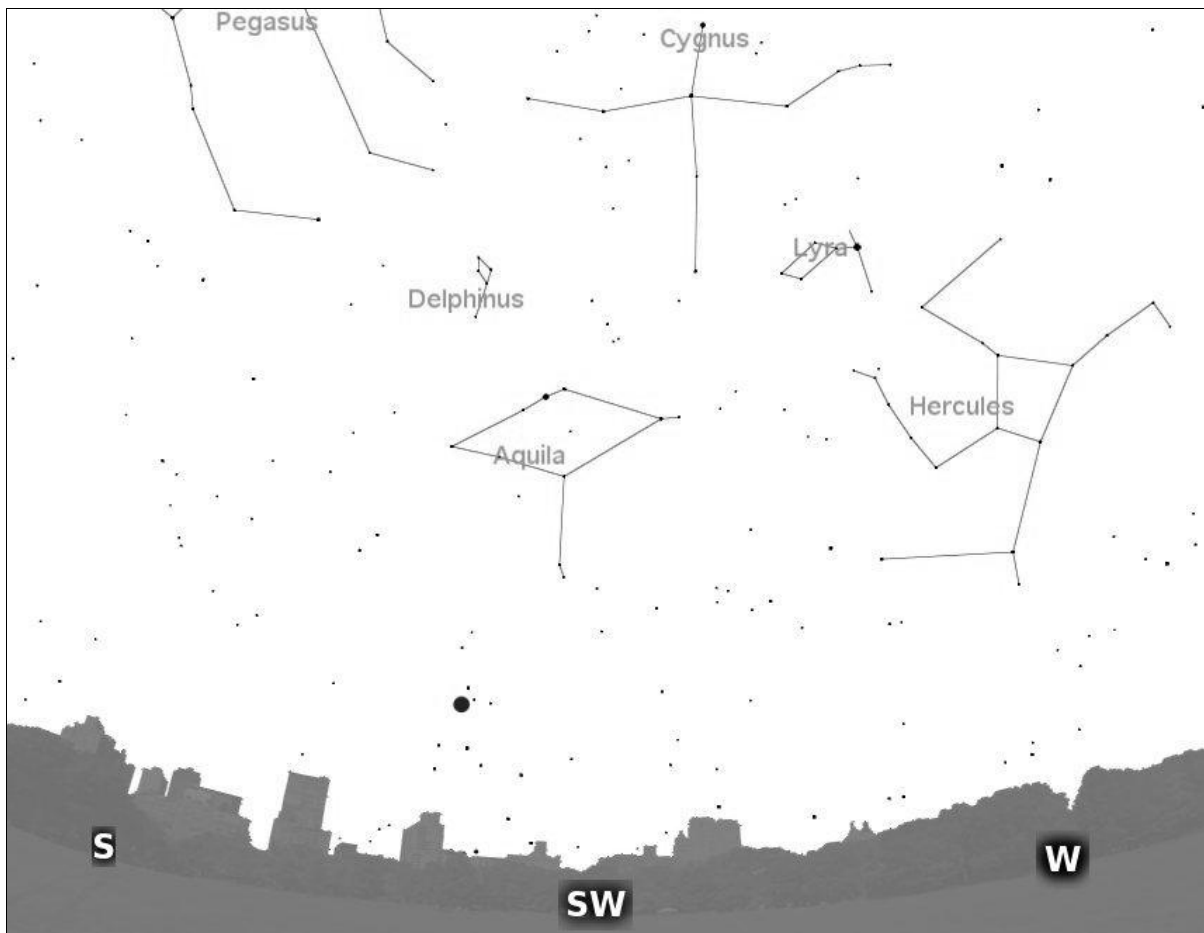


Figure 2: Summer Triangle from NYC about 8pm in late October

That last of our bright stars is Altair in the constellation Aquila (ah-quill-ah). Aquila is another celestial bird, this time an eagle. The eagle is supposed to represent the eagle which picked up and carried off Ganymede to mount Olympus to serve the gods. In some versions of the myth, it was Zeus who took the form of an eagle, in others it was just a bird that was serving Zeus.

2.3.3 Coming Up in the East

While the constellations of the summer are already beginning to set, and Jupiter will soon be invisible, the constellations of the winter are already rising in the east. By the time it gets dark, Pegasus (peg-uh-sus) and Andromeda (an-drom-uh-duh) will have risen in the east and be fairly high in the sky. The star map in Figure 3 shows the sky from the southeast horizon all the way up to overhead. Pegasus is best found by looking for the giant “square” overhead, although it isn't really quite square. And actually, one of the stars in the square belongs to Andromeda. Further north, Cassiopeia looks like a distorted “W” on the sky. The W-shape is supposed to be the throne of Cassiopeia (kas-ee-oh-pea-uh).

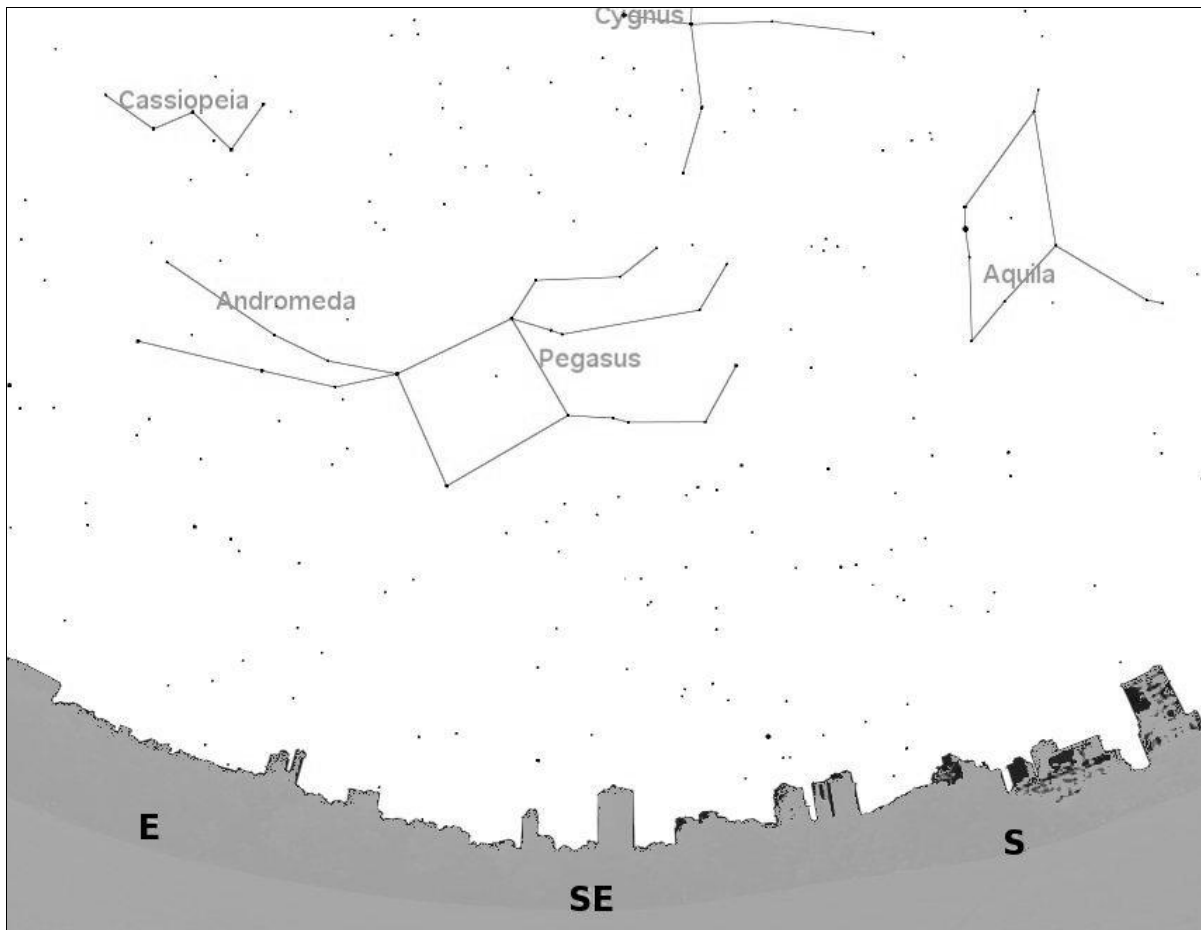


Figure 3: Pegasus Region from NYC around 8pm in late October

Each of these constellations have their own myths, but in this case, they are connected with some other constellations which are a bit fainter. Andromeda was

the daughter of Cepheus (see-fee-us) and Cassiopeia and was chained to a great rock near the coast where she was left to be eaten by Cetus (see-tus), the sea monster. Cetus had been destroying homes and killing people near the coast and Andromeda was the human sacrifice being given to hopefully make Cetus go away. Perseus (another nearby constellation) came to Andromeda's rescue, riding Pegasus, the flying horse, killed Cetus and saved Andromeda.

But the better known story of Pegasus includes a later time and a man named Bellerophon (bell-air-oh-fon). The story is a long one, but in it Bellerophon manages to befriend Pegasus who then allows him to kill a dangerous three-headed beast called the Chimera which had been roaming the countryside killing people and destroying homes. Bellerophon becomes a hero, but after a few years, he let this all go to his head and decided that he deserved a place on Mount Olympus, home of the gods. So, he mounted Pegasus and tried to get the horse to fly him there. According to one version, Pegasus was smarter than his rider and refused by throwing Bellerophon off his back. According to another version, Zeus was displeased with Bellerophon's pride and sent a gadfly (like a horsefly) to bite Pegasus which had the same effect. Bellerophon then fell to his death. Pegasus, however, was allowed to go to Mount Olympus where he lived out the rest of his life.

2.3.4 Summer Milky Way

If you are able to travel to a dark location, someplace well outside NYC, you may be able to see the summer Milky Way as a glowing path running from the southeast in the constellation Sagittarius (where Jupiter is currently located now in fall of 2008), up through the northwest toward Cassiopeia. This glow will be brightest in Sagittarius, but still very noticeable in Aquila and Cygnus. The glow is caused by millions of stars which are part of our galaxy. Individually, they are too far away and too dim to be seen individually with our naked eyes, but their combined light produces a pale milky glow.

No one has reported being able to see any part of the Milky Way from NYC in the past few decades. The reason for this is something called *light pollution*. Light pollution has many sources. Some is caused by excessive lighting like that found on many billboards and gas stations. Much is caused by poorly designed lights like nearly all city streetlights. Being called streetlights, you would expect their light to fall on the street. While most does, at least 30% shines upward into the night sky. The lights installed on the Gowanus overpass a few years ago, and more recently on the BQE south of the Gowanus shine even more into the night sky.

The NYC bridges and tunnels have had well-designed lights installed, as have sections of the Long Island Expressway and some roads in New Jersey. These well-designed lights not only help improve our view of the night sky, but more importantly, help reduce the impact of light pollution on wildlife, help reduce energy use, improve night-time safety, and even human health.

Even during the blackout during August of 2003, the sky glow from all of the lights in New Jersey, across the harbor, where they did not lose power, was so great that the Milky Way was still invisible. There are few places within 100 miles of New York City where the Milky Way is visible, and even then it is a washed-out version of its true

glory

2.4 Vocabulary

These are some useful words that you will encounter when reading web sites or books on astronomy.

twilight

The period of day immediately after sunset and until it becomes truly dark. There are three different twilight definitions: civil, nautical, and astronomical.

civil twilight

This begins at sunset and ends when the sun is 6° below the horizon. In the USA, it is generally accepted that civil twilight lasts about 30 minutes. But this is an average. In Honolulu, it lasts about 22 minutes; here in NYC, it lasts a bit over 30 minutes; In Alaska, it lasts about 50 minutes. But in the summer in Fairbanks, it lasts all night (all two hours of night!).

During civil twilight, the sky is still quite bright. Near the end, the brighter stars will be visible.

nautical twilight

This ends when the sun is 12° below the horizon. This is named because it is the best time for a sailor to use the stars for navigation. Before the days of GPSes, sailors used a tool called a sextant for navigation. To use it, you had to be able to see a few stars but also see the horizon. Before the end of civil twilight, there are few stars visible. By the end of nautical twilight, it is hard to see the horizon.

astronomical twilight

This ends when the sun is 18° below the horizon. Astronomers made this definition because once the sun is 18° below the horizon, the sky overhead is as dark as it is possible for it to get. How long it takes for the sun get 18° below the horizon is different depending on the time of year. In the summer, not only is the daylight portion of the day longer, but it also takes a bit longer for the sun to dip below the 18° mark, so astronomical twilight lasts longer. In the middle of winter, astronomical twilight may last about 90 minutes, while in the summer it may last about two hours!

Here in NYC, due to the large amount of light pollution, the sky never gets much darker than it does during nautical twilight.

light pollution

Light which contributes to the overall brightening of the night-time environment due to misdirection (lights aimed up), poor shielding, or simply being overly bright. Light pollution prevents us from seeing the night sky as it really is and can also have a bad effect on wildlife and even human health!

zenith

This is the imaginary point on the sky directly overhead.

meridian

This is the imaginary line that runs from the north pole, through the zenith, and on to the southern horizon. Object rise in the east, keep getting higher in the sky, cross the meridian, and then begin to set. When they cross the meridian, they are as high up as they will ever get.

2.5 Home Activities

2.5.1 Moon Phases

Continue the Moon phases chart. How many do you have so far? Are you finding any patterns to the phases and when you can see them (and the moon)?

2.5.2 Sky Sketches

Find one of the tree constellations of the Summer Triangle. Sketch the constellation showing all the stars you can find inside the constellation area.

2.5.3 Counting Stars

Find the summer triangle on a fairly clear night. Count how many stars in it you can find inside the boundaries formed by the triangle. If you have the opportunity to travel outside the city, repeat this experiment and compare your numbers. If not, just bring your counts back to share with the class.