What's in the Sky?

Overview: Today you get to learn how to read an astronomical chart to find out when the Sun sets, when twilight ends, which planets are visible, when the next full moon occurs, and much more. This is an excellent way to impress your friends.

What to Learn: The patterns of stars and planets stay the same, although they appear to move across the sky nightly, and different stars and planets can be seen in different seasons.

Materials

- Printout of Stargazer's Almanac
- Pencil
- Tape and scissors (optional)
- Ruler

Experiment

1. If your chart comes on two pages, you'll need to cut the borders off at the top and bottom and tape them together so they fit perfectly.
2. Use your ruler as a straight edge to help locate items as you read the chart.
3. Print out copies of the almanac by clicking the image of the Skygazer's Almanac. You can print it full-size on two pages, or size it to fit onto a single page. Since there's a ton of information on it, it's best read over two pages. This is an expired calendar to practice with.
4. First, note the "hourglass" shape of the chart. Do you see how it's skinnier in the middle and wider near the ends? Since it's an astronomical chart that shows what's up in the sky at night, the nights are shorter during the summer months, so the number of hours the stars are visible is a lot less than during the winter. You'll find the hours of the night printed across the top and bottom of the chart (find it now) and the months and days of the year printed on the right and left side.
5. Can you find the summer solstice on June 20? Use your finger and start on the left side between June 17 and June 24. The 20th is between those two dates somewhere. Here's how you tell exactly…
6. Look at the entire chart – do you see the little dots that make up little squares all over the chart, like a grid? Each dot in the vertical direction represents one day. There are eight dots on the vertical side of the box.
7. Let's say you want to find out what time Neptune rises on June 17. Go back to June 17, which has its own little set of dots. Follow the dots with your finger until you hit the line that says *Neptune Rises*. Stop and trace it up vertically to the top scale to read just after 11 p.m.
8. Look again at the dot boxes. Each horizontal dot is 5 minutes apart, and every six dots there is a vertical line representing the half-hour. The line crosses between the second and third dot, so if you lived in a place where you can clearly see the eastern horizon and looked out at 11:07, you'd see Neptune just rising. Since Uranus and Neptune are so far away, though, you'd need a telescope to see them. So let's try something you can find with your naked eye.
9. Look at Oct 21. What time does Saturn set? (5:30p.m.).
10. What other two planets set right afterward? (Mercury at 6:03 p.m. and Mars sets at 7:12 p.m.).
11. When does Jupiter rise? (7:32 p.m.).
12. What is Neptune doing that night of Oct. 21? (Neptune transits, or is directly overhead, at 8:07 p.m. and sets at 1:30 a.m.)

13. What other interesting things happen on Oct. 21? (Betelgeuse, one of the bright stars in the constellation *Orion*, rises at 9:23 p.m. Sirius, the dog star, rises at 11:06 p.m. The Pleiades, also known as the *Seven Sisters*, are overhead at 1:42 a.m.)
14. Let's find out when the Moon rises on Oct. 21. You'll find a half circle representing the Moon centered on 11:05 p.m. Which phase is the Moon at? First or third quarter? (First. You can tell if you look at the next couple of days to see if the Moon waxes or wanes. Large circles indicate one of the four main phases of the Moon.)
15. When does the Sun rise and set for Oct. 21? First, find the nearest vertical set of dots and read the time (5:30 p.m.). Now subtract out the 5-minute dots until you get to the edge. You should read three dots plus a little extra, which we estimate to be 17 minutes. Sunset is at 5:13 p.m. on Oct 21.
16. Note the fuzzy, lighter areas on both sides of the hourglass. That represents the twilight time when it's not quite dark, but it's not daylight either. There's a thin dashed line that runs up and down the vertical, following the curve of the hourglass offset by about an hour and 35 minutes. That's the official time that twilight ends and the night begins.
17. Can you find a meteor shower? Look for a starburst symbol and find the date right in the center. Those are the peak times to view the shower, and it's usually in the wee morning hours. The very best meteor showers are when there's also a new Moon nearby.
18. Notice how Mercury and Venus stay close by the edges of the twilight. You'll find a half-circle symbol representing the day that they are furthest from the Sun as viewed from the Earth, which is the best date to view it. For Venus, the * indicates the day that it's the brightest.
19. What do you think the open circle means at sunset on May 20? (New Moon)
20. Students that spot the "Sun slow" or "Sun fast" marks on the chart always ask about it. It's actually rather complicated to explain, but here's the best way to think about it. Imagine that the vertical timeline running down the center means noon, not midnight. Do you see a second line weaving back and forth across the noon line throughout the year? That's the line that shows the when the Sun crosses the meridian. On Feb 5, the Sun crosses that meridian at 12:14, so it's "running slow," because it "should have" crossed the meridian at noon. This small variation is due to the axis tilt of the Earth. Note that it never gets much more than 15 minutes fast or slow. The wavy line that represents this effect is called the *Equation of Time*. We'll be using that later when we make our own sundials and have to correct for the Sun not being where it's supposed to be.
21. Look at Mars and Saturn both setting around the same time on Aug. 14. When two event lines cross, you'll find nearby an open circle with a line coming from the top right side, accompanied by a set of arrows pointing toward each other. This means *conjunction*, and is a time when you can see two objects at once. Usually the symbol isn't right at the intersection, because one of the objects is rising or setting and isn't clearly visible. On Aug. 14, you'll want to view them a little before they set, so the symbol is moved to a time where you can see them both more clearly.
22. Important to note: If your area uses daylight savings time, you'll need to add one hour to the times shown on the chart.
23. *Time corrections for advanced students:* This chart was made for folks living on the 40° north latitude and 90° west longitude lines (which is Peoria, Ill.).
    a. If you live near the standardized longitudes for Eastern Time (75°), Central (90°), Mountain (105°) or Pacific (120°), then you don't have to correct the chart times you read. However, if you live a little west or east of these standardized locations, you need a correction, which looks like this:
        i. For every degree west, add four minutes to the time you read off the chart.
        ii. For every degree east, subtract four minutes from the time.
        iii. For example, if you lived in Washington, D.C. (which is 77° longitude), note that this is 2° west of the Eastern Time, so you'd add 8 minutes to the time you read off the chart.
        iv. Memorize your particular adjustment and always use it.

b. If your latitude isn't 40° north, then you need to adjust the rise and set times like this:
    i. If you live north of 40°, then the object you are viewing will be in the sky for longer than the chart shows, as it will rise earlier and set later.
    ii. If you live south of 40°, then the object you are viewing will be in the sky for less time than the chart shows, as it will rise later and set earlier.
    iii. The easiest way to calculate this is to note what time an object *should* rise, and then watch to see when it actually appears against a level horizon. This is your correction for your location.

24. Complete the data table.

"What's in the Sky?" Data Table

Question	Answer (date and time)
What time does Venus set on April 22?	
When does Mars set on August 12?	
When is the full Moon in March?	
When is the best date and time to view both Jupiter and Saturn?	
When is the best meteor shower for the entire year?	
Which day is the longest?	
When do two planets rise at the same time?	
If this calendar was for this year at your exact location, what would you be looking forward to tonight?	

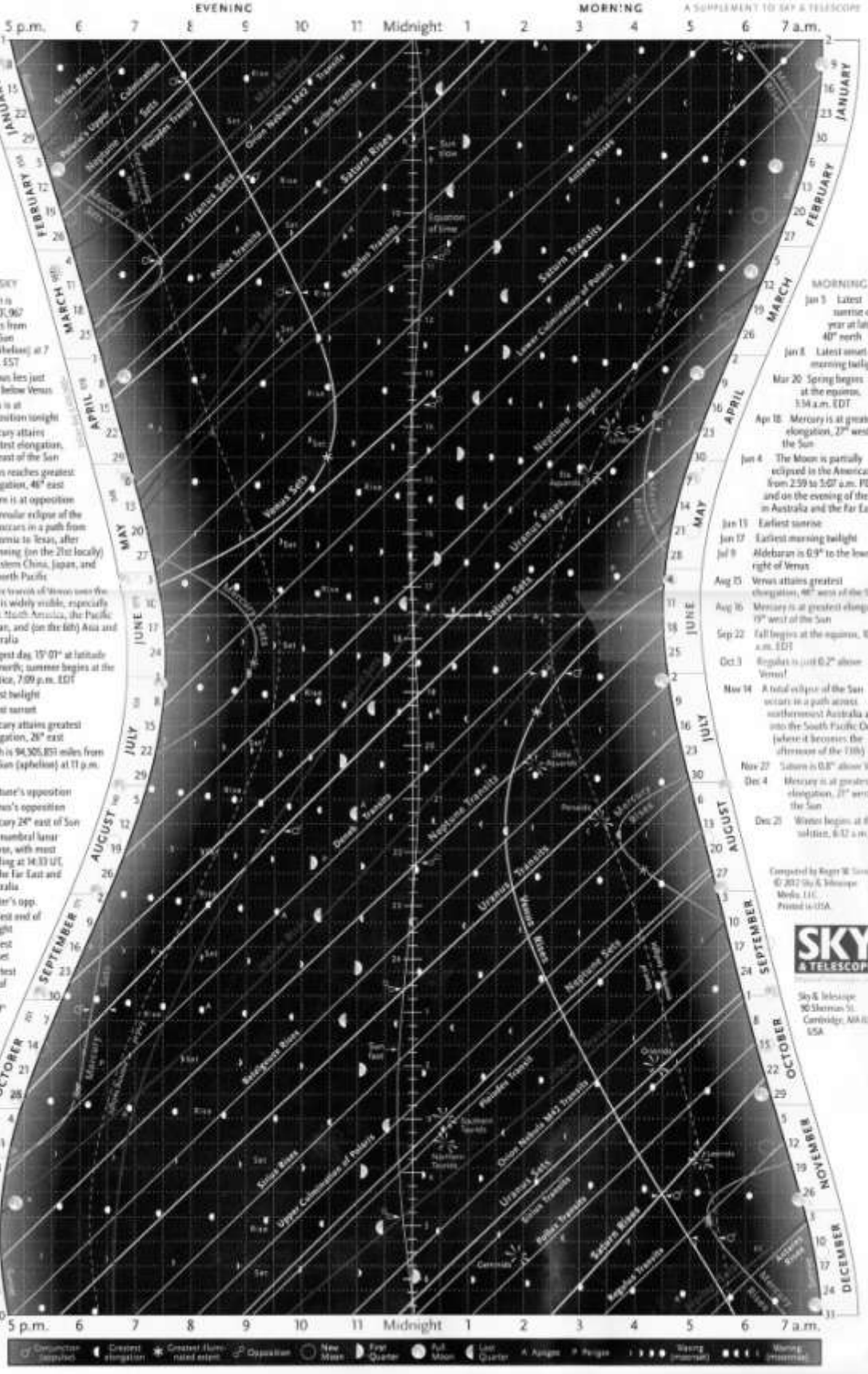
Reading

This is one of the finest charts I've ever used as an astronomer, as it has so much information all in one place. You'll find the rise and set times for all eight planets, peak times for annual meteor showers, moon phases, sunrise and set times, and it gives an overall picture of what the evening looks like over the entire year. Kids can clearly see the planetary movement patterns and quickly find what they need each night. I keep one of these posted right by the door for everyone to view all year long.

Skygazer's Almanac 2012

FOR LATITUDES NEAR 40° NORTH

A SUPPLEMENT TO SKY & TELESCOPE



EVENING SKY

Jan 4 Earth is 91,401,967 miles from the Sun (perihelion) at 7 p.m. EST

Feb 9 Uranus lies just 0.3° below Venus

Mar 3 Mars is at opposition tonight

Mar 4 Mercury attains greatest elongation, 18° east of the Sun

Mar 26 Venus reaches greatest elongation, 46° east

Apr 14 Saturn is at opposition

May 20 An annular eclipse of the Sun occurs in a path from California to Texas, after beginning (on the 21st locally) in eastern China, Japan, and the north Pacific

Jun 5 A rare transit of Venus sees the Sun is widely visible, especially from North America, the Pacific Ocean, and (on the 6th) Asia and Australia

Jun 20 Longest day, 15h 07m at latitude 40° north; summer begins at the solstice, 7:09 p.m. EDT

Jun 24 Latest twilight

Jun 27 Latest sunset

Jun 30 Mercury attains greatest elongation, 26° east

Jul 4 Earth is 94,505,851 miles from the Sun (aphelion) at 11 p.m. EDT

Aug 23 Neptune's opposition

Sep 28 Uranus's opposition

Oct 26 Mercury 24° east of Sun

Nov 28 A penumbral lunar eclipse, with most shading at 14:33 UT, for the Far East and Australia

Dec 2 Jupiter's opp.

Dec 4 Earliest end of twilight

Dec 7 Earliest sunset

Dec 21 Shortest day of year, 9h 20m

MORNING SKY

Jan 1 Latest sunrise of the year at latitude 40° north

Jan 8 Latest onset of morning twilight

Mar 20 Spring begins at the equinox, 5:14 a.m. EDT

Apr 18 Mercury is at greatest elongation, 27° west of the Sun

Jun 4 The Moon is partially eclipsed in the Americas from 2:59 to 5:07 a.m. PDT, and on the evening of the 4th in Australia and the Far East

Jun 13 Earliest sunrise

Jun 17 Earliest morning twilight

Jul 9 Aldebaran is 0.9° to the lower right of Venus

Aug 15 Venus attains greatest elongation, 46° west of the Sun

Aug 16 Mercury is at greatest elongation, 19° west of the Sun

Sep 22 Fall begins at the equinox, 10:49 a.m. EDT

Oct 3 Regulus is just 0.2° above Venus!

Nov 14 A total eclipse of the Sun occurs in a path across northernmost Australia and into the South Pacific Ocean (where it becomes the afternoon of the 13th)

Nov 27 Saturn is 0.8° above Venus

Dec 4 Mercury is at greatest elongation, 21° west of the Sun

Dec 21 Winter begins at the solstice, 6:12 a.m. EST

Computed by Roger W. Sinnott
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Exercises

1. Is Mercury visible during the entire year?
2. In general, when and where should you look for Venus?
3. When is the best time to view a meteor shower?
4. Which date has the most planets visible in the sky?

Answers to Exercises: What's in the Sky?

"What's in the Sky?" Data Table

Question	Answer (date and/or time)
What time does Venus set on April 22?	10:35 p.m.
When does Mars set on August 12?	9:30 p.m.
When is the full Moon in March?	March 8
When is the best date and time to view both Jupiter and Saturn?	(answers vary, but Sept. 9 is a choice)
When is the best meteor shower for the entire year?	(answers vary, but Lyrids and Leonids are great choices with nearly no moon)
Which day is the longest?	Dec. 21
When do two planets rise at the same time?	4:30 a.m. on Nov. 27
If this calendar was for this year at your exact location, what would you be looking forward to tonight?	(answers vary)

1. Is Mercury visible during the entire year? (No, only for a couple of months.)

2. In general, when and where should you look for Venus? (Near the Eastern or Western sky during twilight during certain months of the year, because it's always rising or setting, never transiting.)

3. When is the best time to view a meteor shower? (Look for a starburst symbol that is close to a new moon symbol. The skies will be dark enough to view the meteors.)

4. Which date has the most planets visible in the sky? (Feb. 12 has all 7 planets visible sometime during the night, although Nov. 11 is a better night to view, since Mercury and Neptune won't be lost in the sunset.)