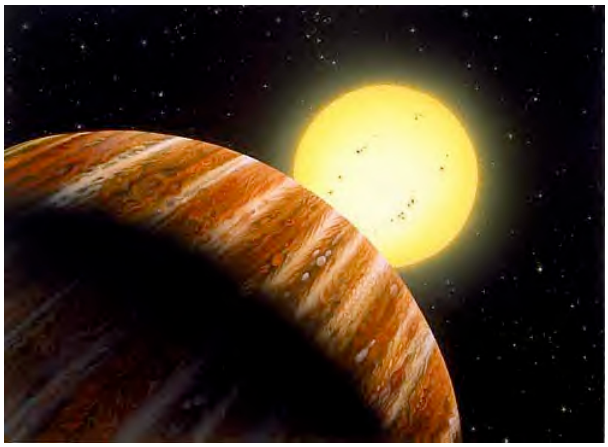
Where Are the Distant Worlds? Star Maps

About the Activity

Where are the distant worlds in the night sky? Use a star map to find constellations and to identify stars with extrasolar planets. (Northern Hemisphere only, naked eye)



Topics Covered

- How to find constellations
- Where we have found planets around other stars

Participants

Adults, teens, families with children 8 years and up
If a school/youth group, 10 years and older
1 to 4 participants per map

Materials Needed

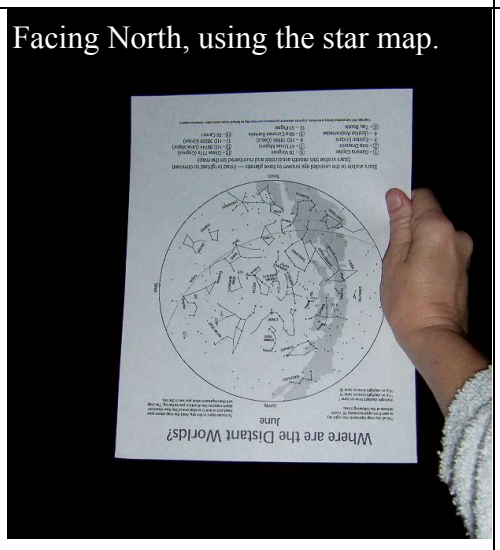
- Current month's Star Map for the public (included)
- A small (red) flashlight
- *(Optional)* Print list of *Visible Stars with Planets* (included)

Location and Timing

Use this activity at a star party on a dark, clear night. Timing depends only on how long you want to observe.

Included in This Packet	Page

Detailed Activity Description

Leader's Role	**Participants' Roles (Anticipated)**
Introduction: *To Ask:* Who has heard that scientists have found planets around stars other than our own Sun? How many of these stars might you think have been found? Anyone ever see a star that has planets around it? (our own Sun, some may know of other stars) We can't see the planets around other stars, but we can see the star. And I can tell you some about what those systems might look like. *To Say:* We're going to look at a map that will show us where to find these stars in the sky. NASA missions are finding more and more stars with planets orbiting them all the time. It's part of the ultimate search for planets might have life! We'll use the star map to find the constellations and then find the stars within them where we've detected planets.	Participants begin to think about and respond to questions about extrasolar planets beyond our Solar System.
To Ask: What's a constellation? (make sure the participants understand)	Participants share, learn, or are reminded of what constitutes a constellation.
To Do: Demonstrate how to use the star map to find a constellation and one of the stars. Assist participants in finding other constellations and stars with planets. **To demonstrate how to use a star map:** If facing North, hold the map up against the sky and orient the star map so that North on the map is down - toward the northern horizon (see photo to the right). If facing East, orient the map so that East on the star map is down toward the eastern horizon. Facing North, using the star map.  	Participants practice using a star map to find constellations and stars with planets.

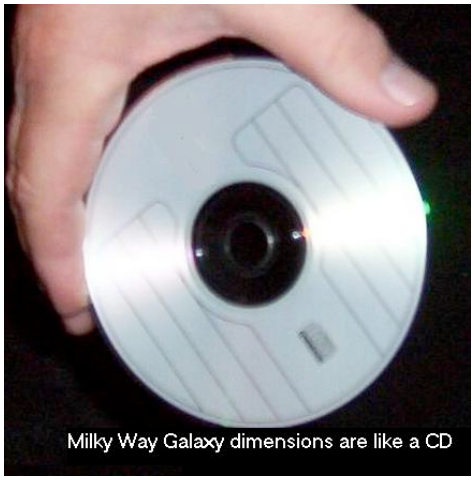
Leader's Role	**Participants' Roles (Anticipated)**
Talking about possibly visiting exoplanets *To Say:* Do you think travel between the stars is possbile? Let's think about it. The fastest speed recorded for a spacecraft was 150,000 miles per hour, reached by the Helios satellite that is in orbit around the Sun. That's 42 miles per *second*. *To Ask:* The nearest star system to us is Alpha Centauri. It's about 4 light years away. How long do you would it take to for us to get to these stars from our solar System, traveling at the speed of our fastest spacecraft? (Light travels at 186,000 miles per second and our fastest spacecraft travels at about 42 miles per second) The spacecraft would travel at 2/10,000th the speed of light (42 divided by 186,000 = 0.00022). So 1 light year would take 5,000 years. Alpha Centauri is about 4 light years from us. So . . . 4 years X 5,000 = 20,000 YEARS to get there. *To Discuss:* • What would we have to do to take such a trip? • How would we stay in communication with the spacecraft? • Would a manned or unmanned spacecraft be a better idea? Why? • How long would it take for us to know the spacecraft had arrived? • How different do you think Earth will be in 20,000 years?	

Helpful Hints

- TO PROMOTE YOUR CLUB: You may want to copy your club's information and schedule on the back side of the star map which you hand out.

- Emphasize that the stars marked on the star maps have planetary systems of their own, just like our star, the Sun, does.

- When you discuss other stars that have planets, some people may think you mean that some of OUR planets (like Jupiter or Saturn) are near other stars. A common misconception is that the stars are sprinkled among the planets of our Solar System. A discussion of stellar distances is instructive. The visible part of our Milky Way Galaxy is about 100,000 light years across and where we are it is about 1000 light years thick. You can use an example where the distance across our Solar System is a bit bigger than a quarter (with the Sun as a grain of sand in the center of the quarter) and the NEAREST star (4 light years away) is 2 football-field lengths away. The Milky Way Galaxy would span the United States (about 2500 miles) and be about 25 miles thick – about the same relative dimensions as a CD (100 to 1). To imagine the 200 billion stars in our Galaxy, think of building a four-foot high wall all around a football field and then filling it with birdseed. That's roughly 200 billion bird seeds. Now imagine distributing those seeds (stars) over the entire USA, 25 miles deep. The stars are VERY far apart!


Milky Way Galaxy dimensions are like a CD

- If the participant has heard of the Voyager missions from the 1970's, these spacecraft have passed well beyond the orbit of Pluto. Many people think these spacecraft are now "among the stars". On the slightly-larger-than-quarter-sized model of our Solar System, The Voyager spacecraft are only about 2-3 inches beyond the edge of the quarter – still VERY far from even the nearest star.

Background Information

- **Planet Naming Conventions:**

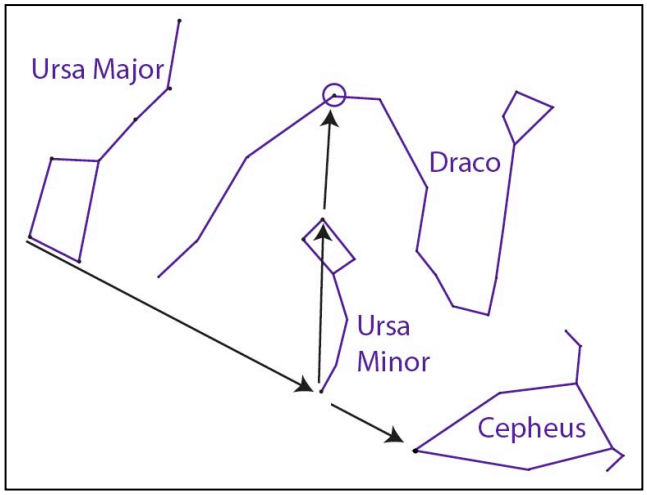
  You may have noticed that the planets around a star are named b, c, d, as in gamma Cephei b, or Upsilon Andromeda b, Upsilon Andromeda c, and so on.

You may have wondered why there is no “a” planet. As premier extra-solar planet hunter Debra Fisher explains it:
“The "A" component is reserved for the star. The default naming convention (since the IAU hasn't jumped in) is that the first detected planet is "b" continuing alphabetically. Usually, the first detected planet is the inner one (Keplerian biases) but in one case, GJ 876, the outer planet was discovered first. So GJ 876 b is the outer planet, and GJ 876 c is the inner planet.”

The IAU is the Internal Astronomical Union and is the organization that performs such tasks as setting naming conventions of astronomical objects. In 2009, the Organizing Committee of IAU Commission 53 Extrasolar Planets (WGESP) on exoplanets discussed the possibility of giving popular names to exoplanets in addition to their existing catalogue designation (for instance HD 85512 b). Although no consensus was reached, the majority was not in favor of this possibility at the time.
However, considering the ever increasing interest of the general public in being involved in the discovery and understanding of the Universe, the IAU decided in 2013 to restart the discussion of the naming procedure for exoplanets and assess the need to have popular names as well. In 2013 the members of Commission 53 will be consulted in this respect and the result of this will be made public here:
http://www.iau.org/public/themes/naming/#exoplanets

Note also that when there is a binary star, the two stars are called, for example, Sirius A and Sirius B. The upper case A or B refers to stars. Lower case b, c, etc. refers to the planets.

- **Finding the brightest stars with planets**



Two of the brightest Northern Hemisphere stars with planets are gamma Cephei and iota Draconis. Fortunately they are visible almost all year and are fairly easy to find, even though they are only about 3rd magnitude. Note in the figure that you can use the pointer stars from the Big Dipper to point to the North Star (Polaris) and then just continue on another 20 degrees or so to gamma Cephei. Iota Draconis is found by starting at the North Star, drawing a line through the star at the "bottom" of the Little Dipper and continuing on to iota Draconis.

For the latest updates on the number of confirmed exoplanets, go to: http://planetquest.jpl.nasa.gov/

For information on the Kepler Mission, designed to explore the structure and diversity of planetary systems by surveying a large sample of stars: http://kepler.nasa.gov/

Visible Stars With Planets

Brightest visible in the Northern Hemisphere as of 2013

	Star Name	Distance from us (ly)	Constellation	Planet Name	Mass (in Jupiter masses)	Distance from star (in AU)	Orbital period (in days)
1	Pollux	34	Gemini	Beta Geminorum b	> 2.3	1.6	590
2	Fomalhaut	25	Piscis Austrinus	Fomalhaut b	< 2	115	320,000
3	Alpha Arietis	66	Aries	Alpha Arietis b	> 1.8	1.2	381
4	Gamma Leonis	130	Leo	Gamma Leonis A b	> 8.8	1.2	429
5	Gamma Cephei	45	Cepheus	Gamma Cepheus b	> 1.6	2	903
6	Iota Draconis	103	Draco	Iota Draconis b	> 8.8	1.3	511
7	Epsilon Tauri	147	Taurus	Epsilon Tauri b	> 7.6	1.9	595
8	Epsilon Eridani	11	Eridanus	Epsilon Eridani b	> 1.5	3.3	2,500
9	Nu Canis Majoris	64	Canis Major	7 Canis Major b	> 2.6	2	760
10	Upsilon Andromeda	44	Andromeda	Upsilon Andromedae b	> 0.82	0.06	4
		44	Andromeda	Upsilon Andromedae c	> 1.8	0.8	241
		44	Andromeda	Upsilon Andromedae d	> 3.8	2.5	1,276
		44	Andromeda	Upsilon Andromedae e	> 1	5.2	3,849
11	91 Aquarii	150	Aquarius	91 Aquarii b	> 2.9	0.7	181
12	HD 60532	84	Puppis	HD 60532 b	> 3.15	0.8	202
		84	Puppis	HD 60532 c	> 7.46	1.6	607
13	Tau Bootis	51	Bootes	Tau Bootes b	> 6	0.05	3
14	Chi Virginis	294	Virgo	Chi Virginis b	> 11	2.14	835
15	Xi Aquilae	200	Aquilla	Xi Aquillae b	> 2.8	0.68	137
16	61 Virginis	28	Virgo	61 Virginis b	> 5.3	0.05	4
		28	Virgo	61 Virginis c	> 19	0.2	38
		28	Virgo	61 Virginisd	> 24	0.5	123
17	Kappa Coronae Borealis	102	Corona Borealis	Kappa Coronae Borealis b	> 1.8	2.7	1,208
18	42 Draconis	315	Draco	42 Draconis b	> 3.9	1.2	480
19	70 Virginis	59	Virgo	70 Virginis b	> 7.5	0.5	117
20	11 Ursae Minoris	390	Ursa Minor	11 Ursae Minoris b	> 10.5	1.5	516

Distances in light-years (ly) and Astronomical Units (AU).
Jupiter has about 318 times the mass of Earth. The smallest planet listed here is much larger than Saturn, though Earth-sized exoplanets have been detected as well.

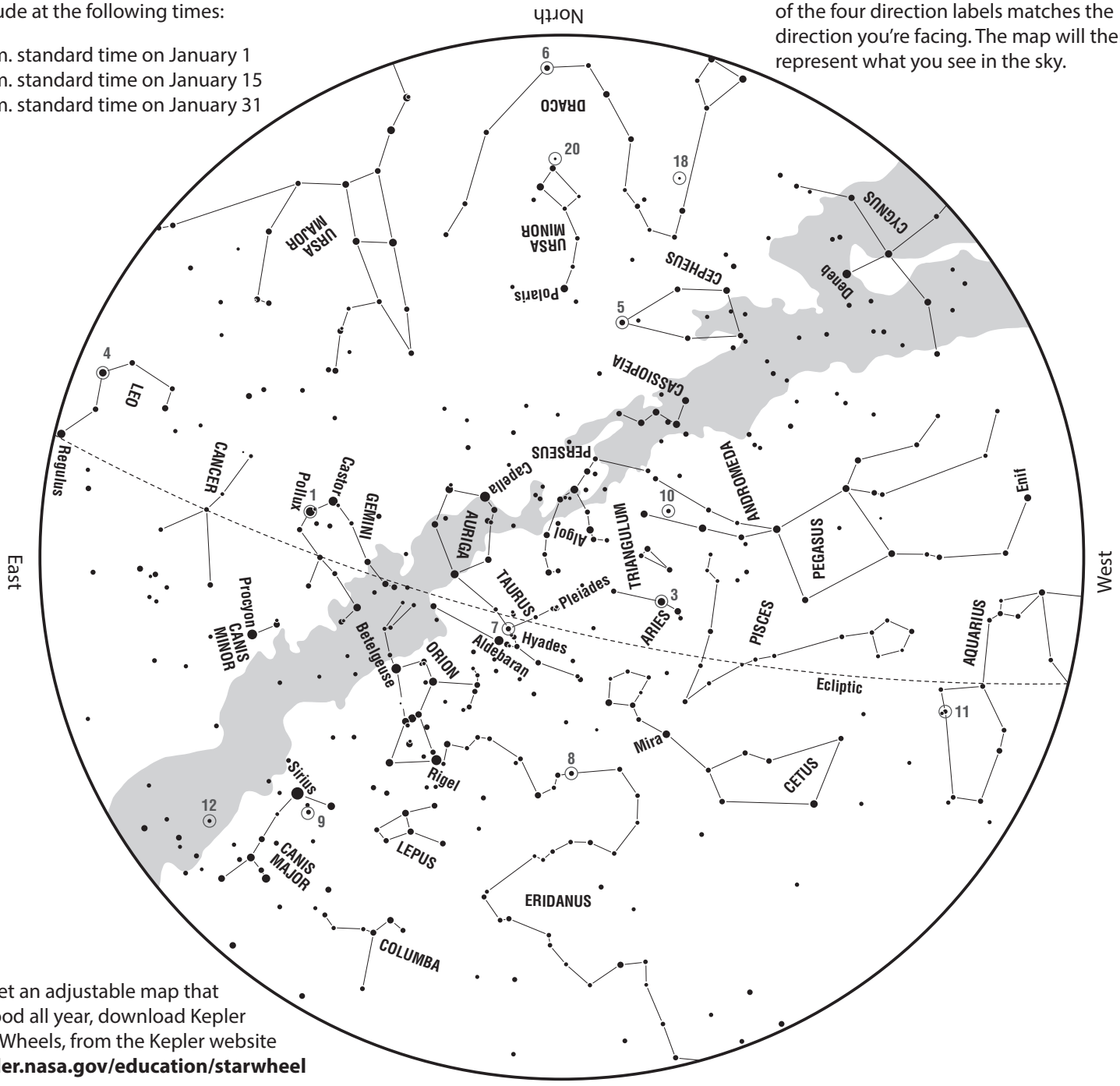
Where are the Distant Worlds?

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

9 p.m. standard time on January 1
8 p.m. standard time on January 15
7 p.m. standard time on January 31

January

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



To get an adjustable map that is good all year, download Kepler Star Wheels, from the Kepler website **kepler.nasa.gov/education/starwheel**

Stars visible to the unaided eye known to have planets — listed brightest to dimmest
(stars visible this month are circled and numbered on the map)

(1) – Pollux (Gemini)
2 – Fomalhaut (Piscis Austrinus)
(3) – Alpha Arietis
(4) – Gamma Leonis
(5) – Gamma Cephei
(6) – Iota Draconis
(7) – Epsilon Tauri
(8) – Epsilon Eridani
(9) – NU Canis Majoris
(10) – Upsilon Andromeda
(11) – 91 Aquarii
(12) – HD 60532
13 – Tau Bootis
14 – Chi Virginis
15 – Xi Aquilae
16 – 61 Virginis
17 – Kappa Coronae Borealis
(18) – 42 Draconis
19 – 70 Virginis
(20) – 11 Ursae Minoris

Where are the Distant Worlds?

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

9 p.m. standard time on February 1
8 p.m. standard time on February 15
7 p.m. standard time on February 28

February

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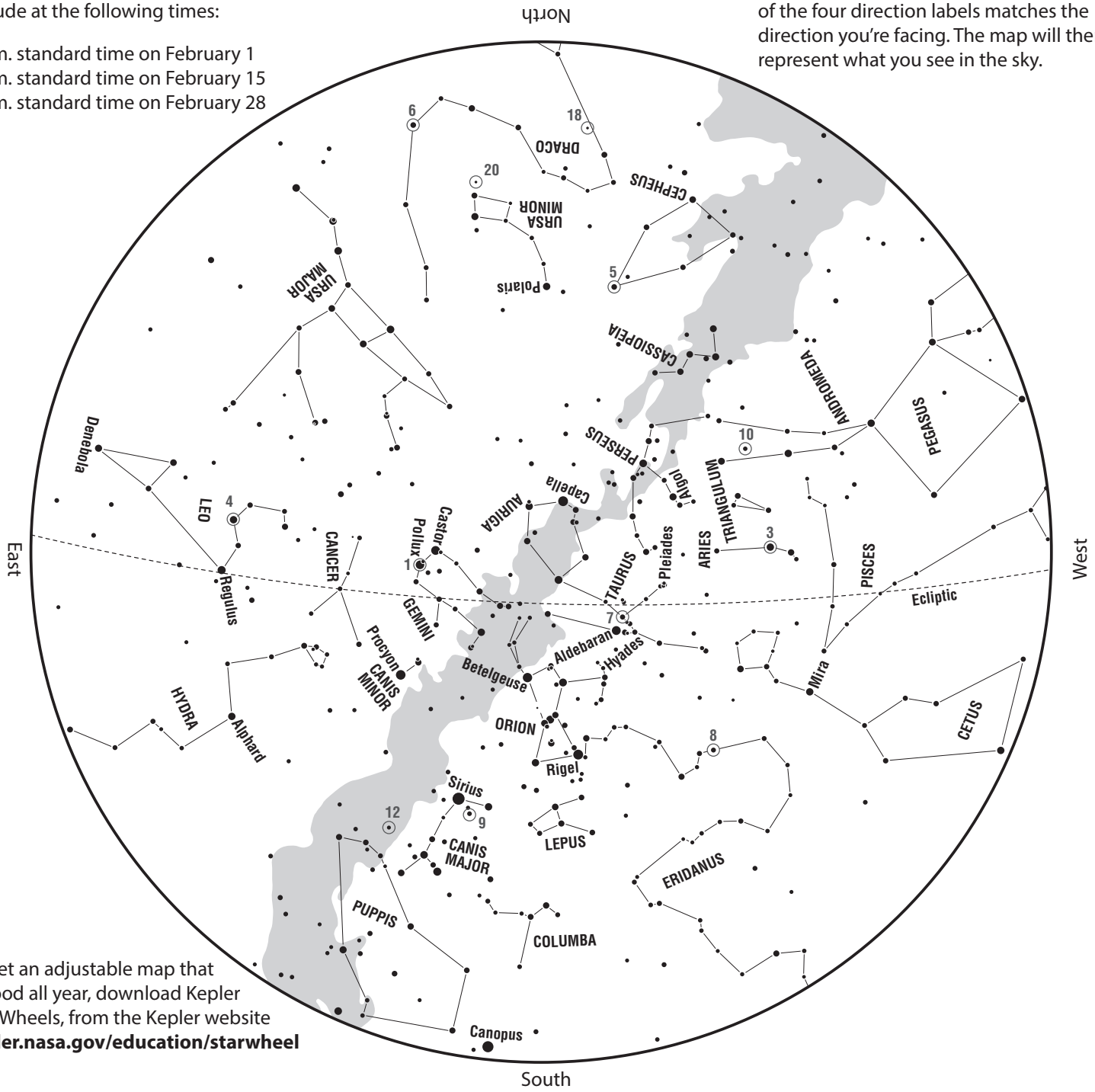

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10 p.m. standard time on March 1
9 p.m. standard time on March 15
8 p.m. standard time on March 31

March

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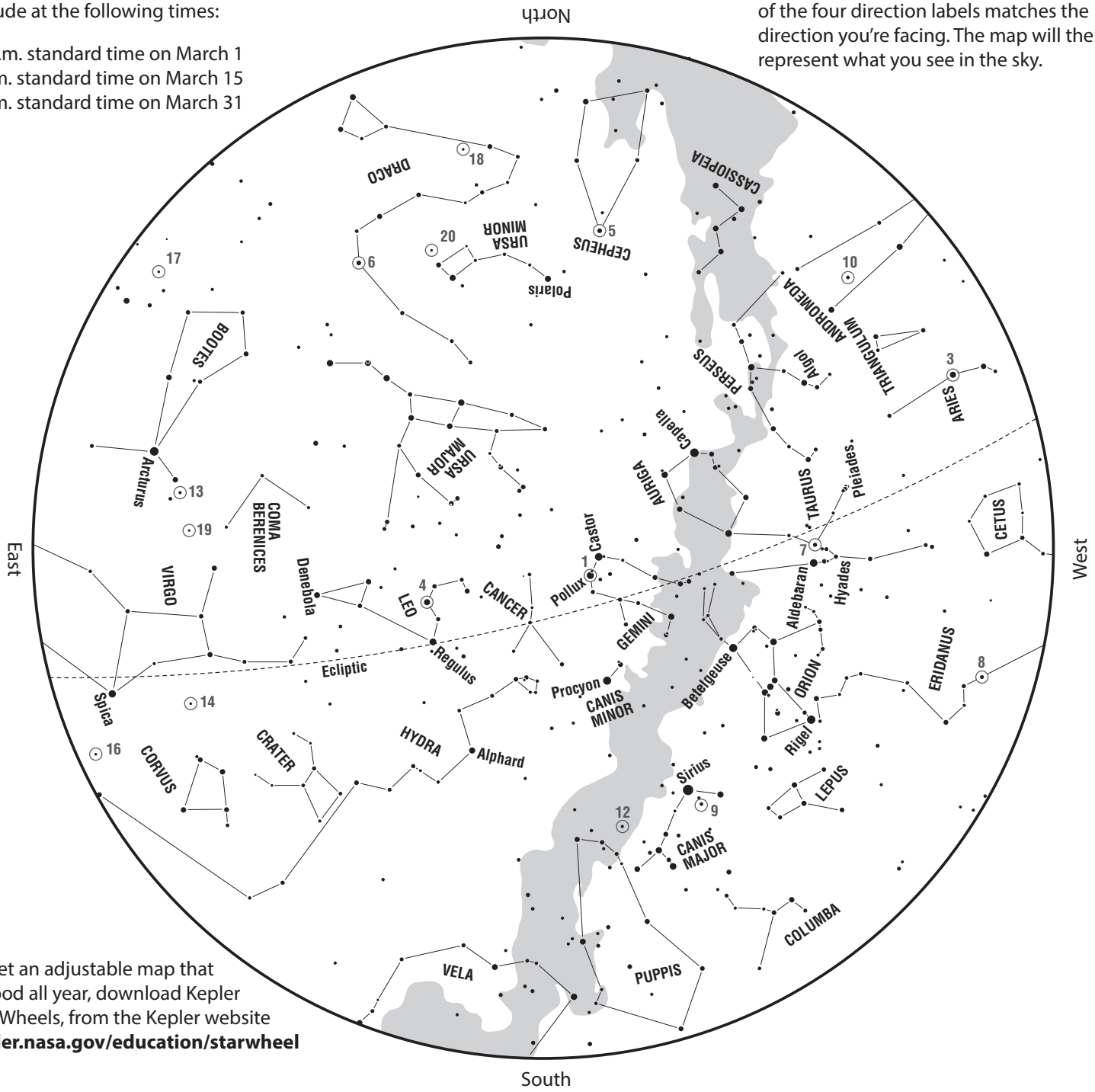

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The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

10 p.m. standard time on April 1
10 p.m. daylight time on April 15
9 p.m. daylight time on April 30

April

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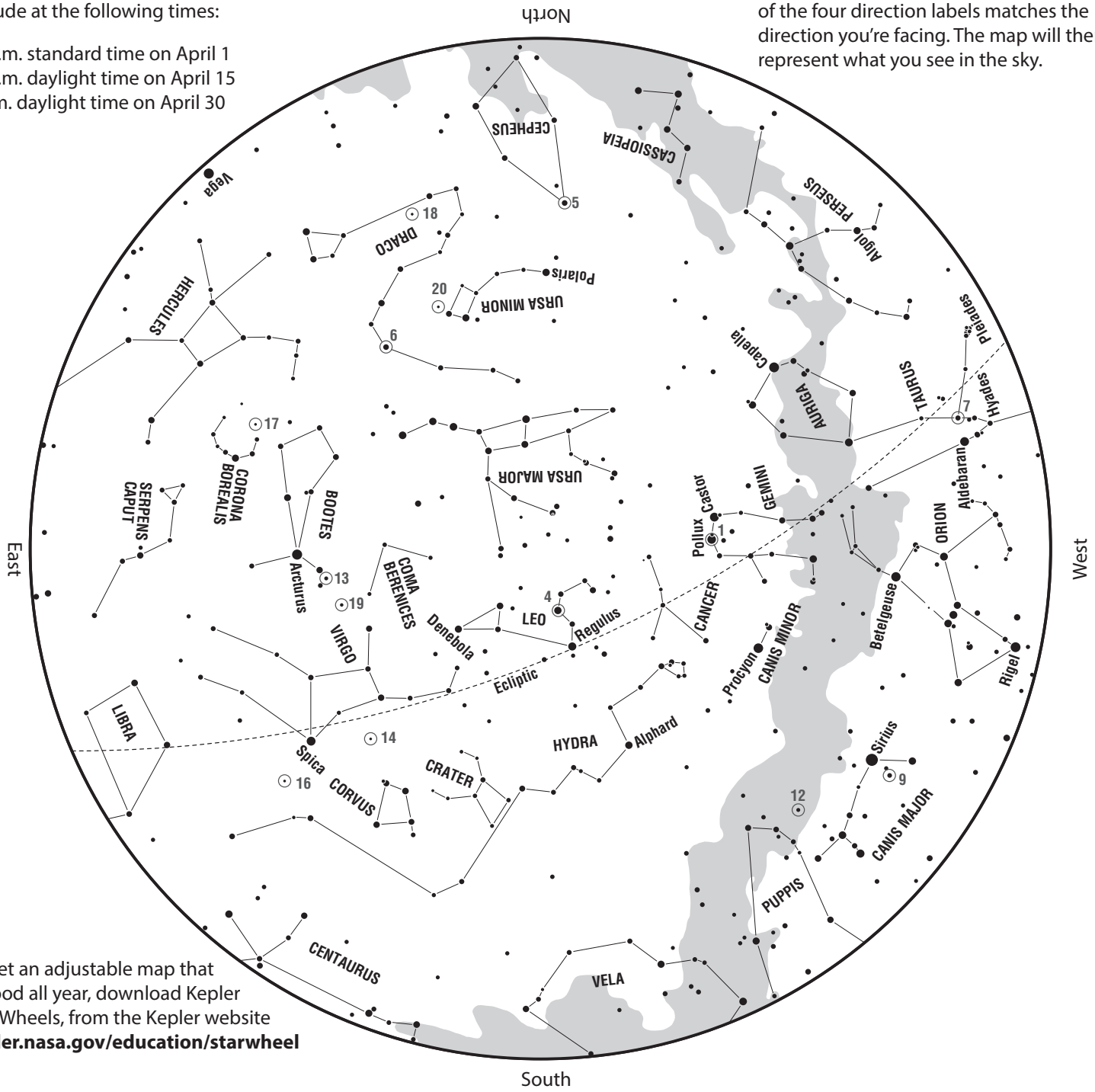

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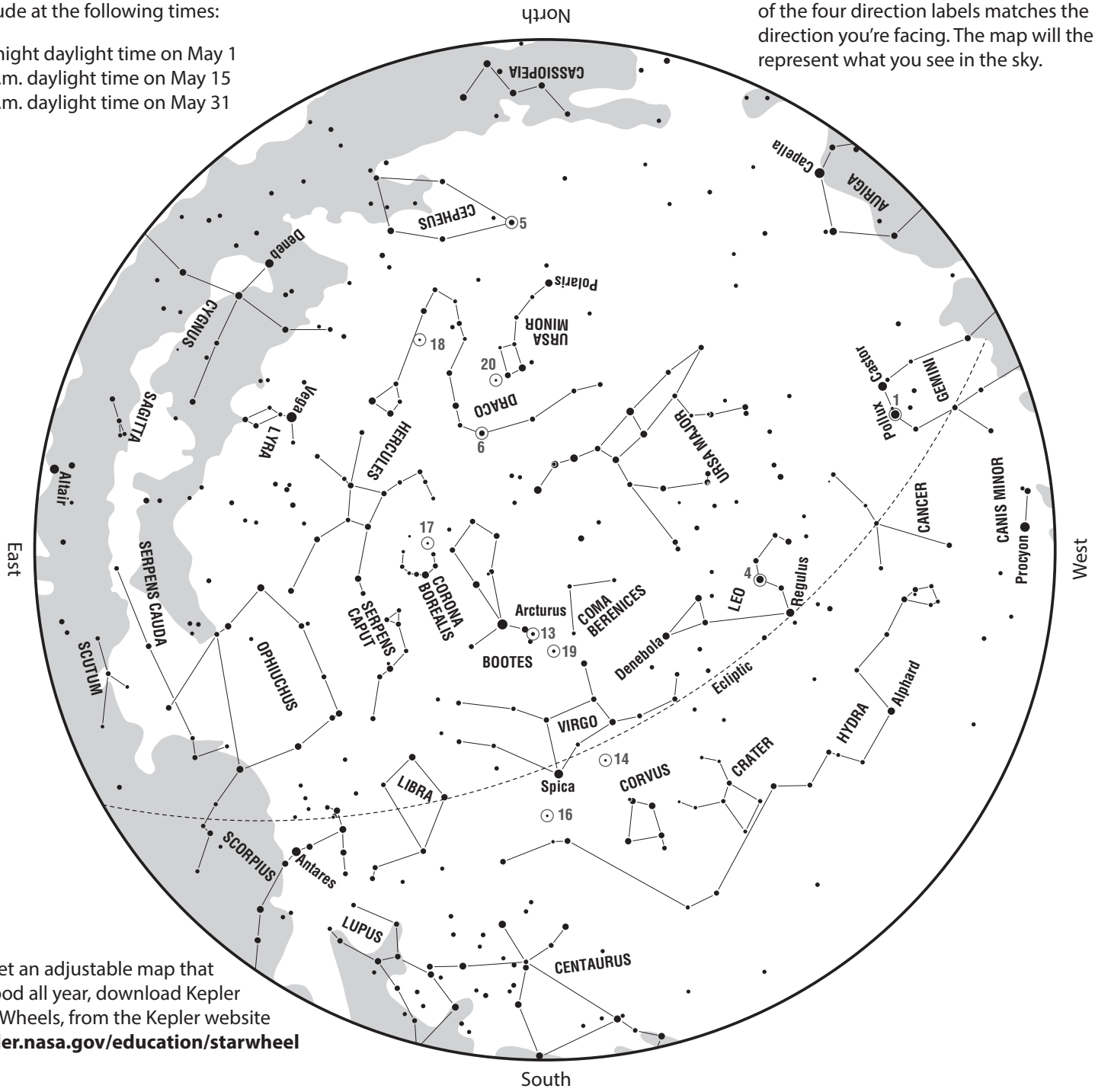
The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

midnight daylight time on May 1
11 p.m. daylight time on May 15
10 p.m. daylight time on May 31

May

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



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The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

midnight daylight time on June 1
11 p.m. daylight time on June 15
10 p.m. daylight time on June 30

June

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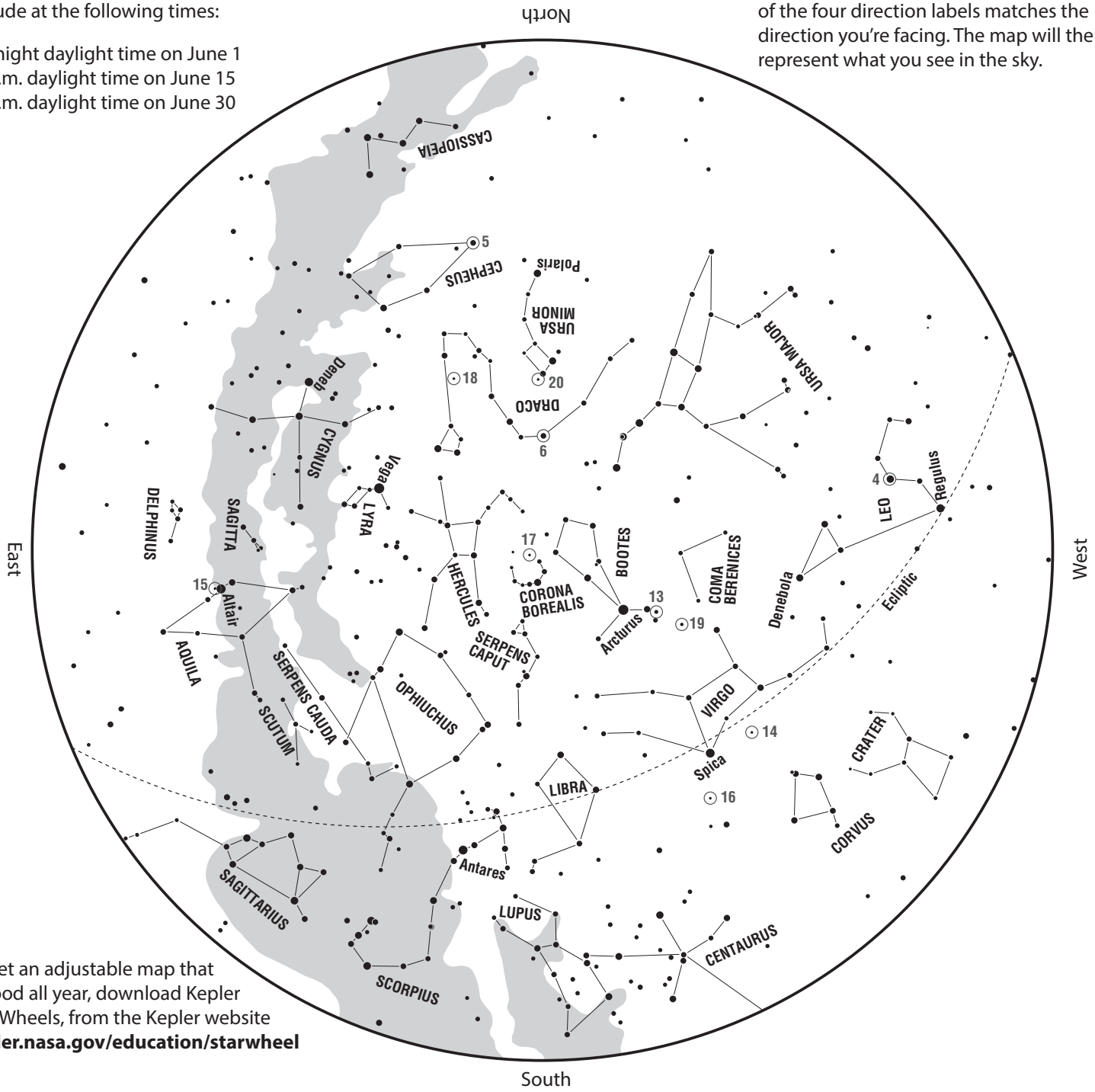

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The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

midnight daylight time on July 1
11 p.m. daylight time on July 15
10 p.m. daylight time on July 31

July

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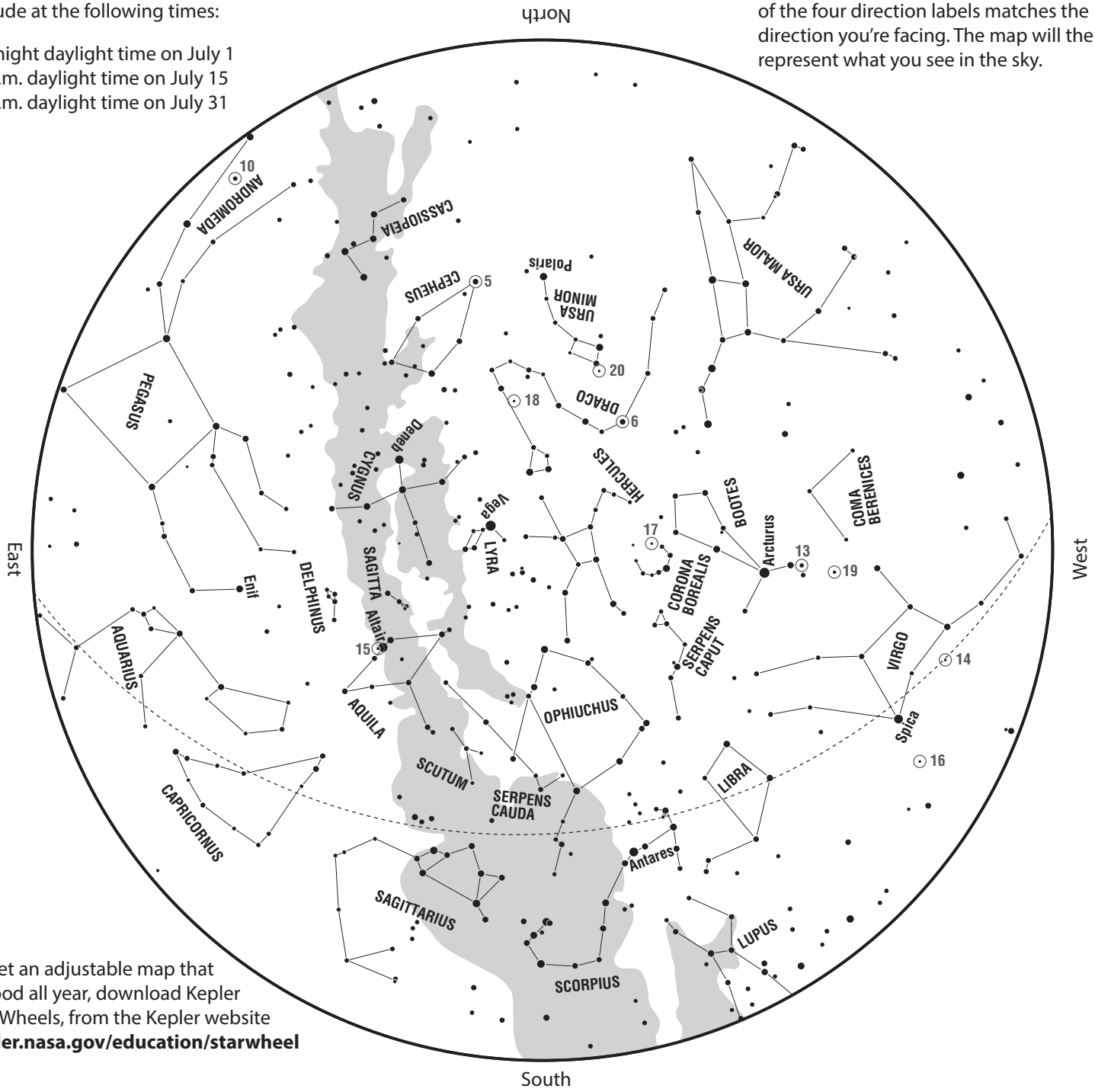

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11 p.m. daylight time on August 1
10 p.m. daylight time on August 15
9 p.m. daylight time on August 31

August

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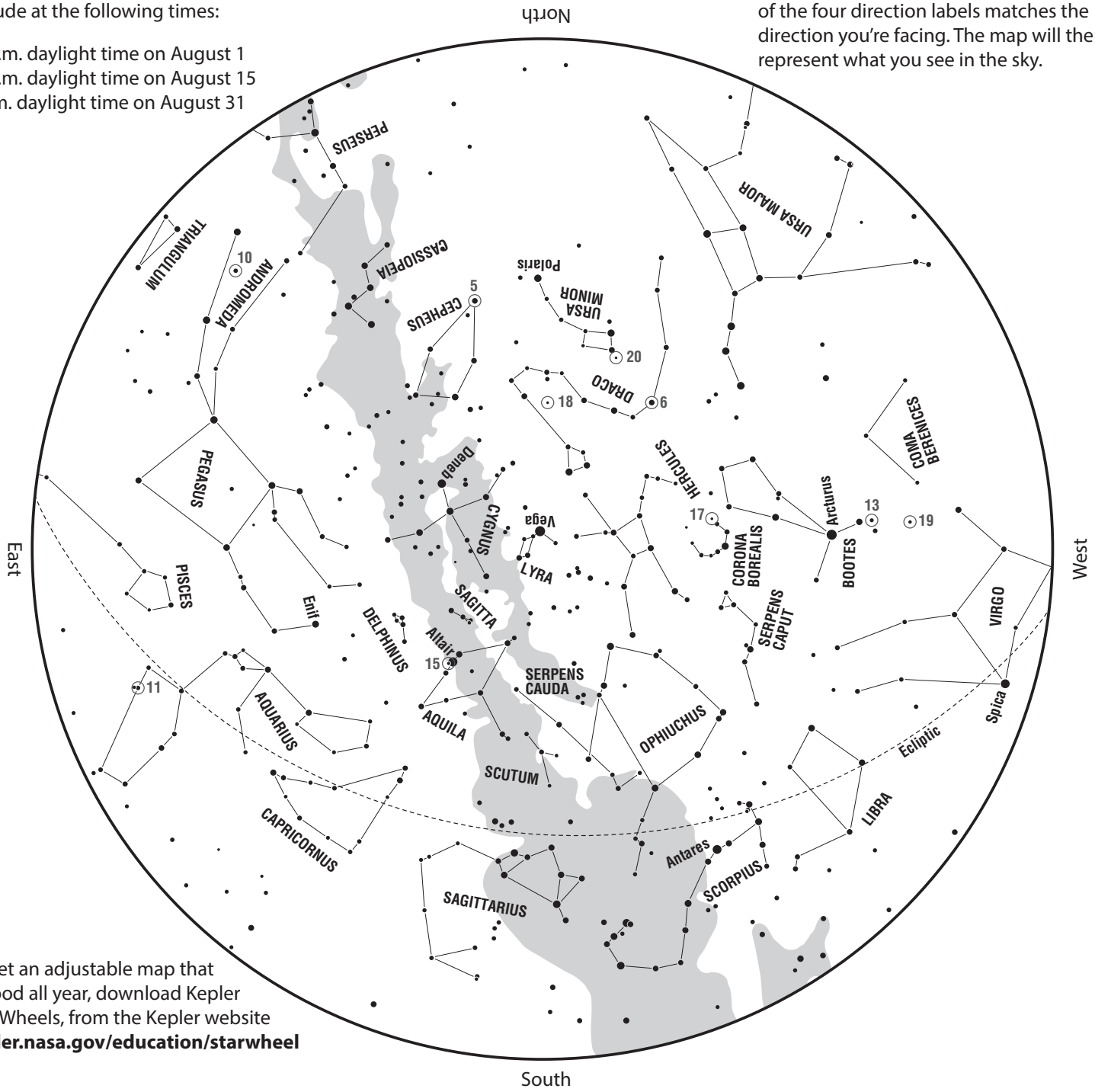

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10 p.m. daylight time on September 1
9 p.m. daylight time on September 15
8 p.m. daylight time on September 30

September

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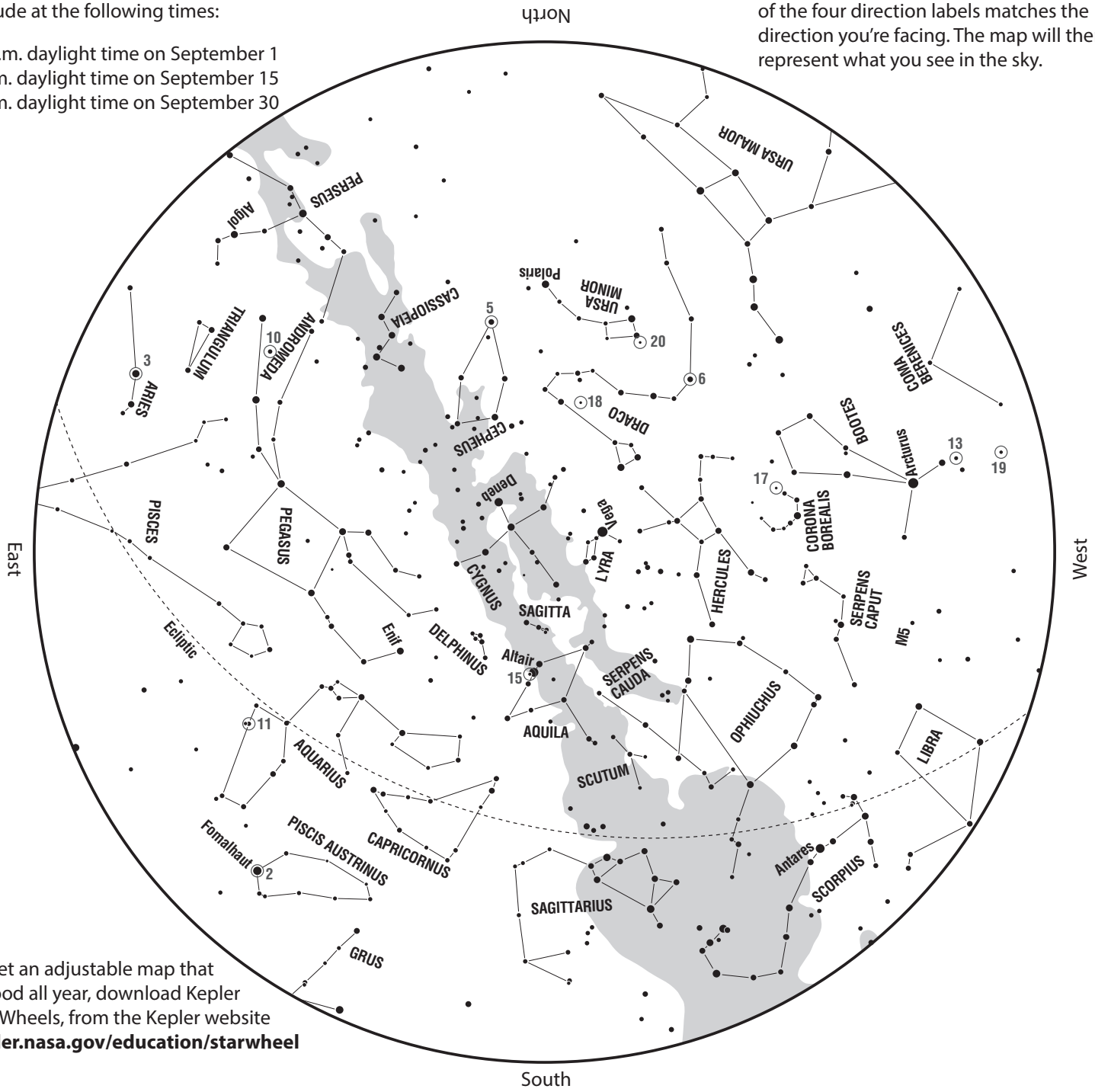

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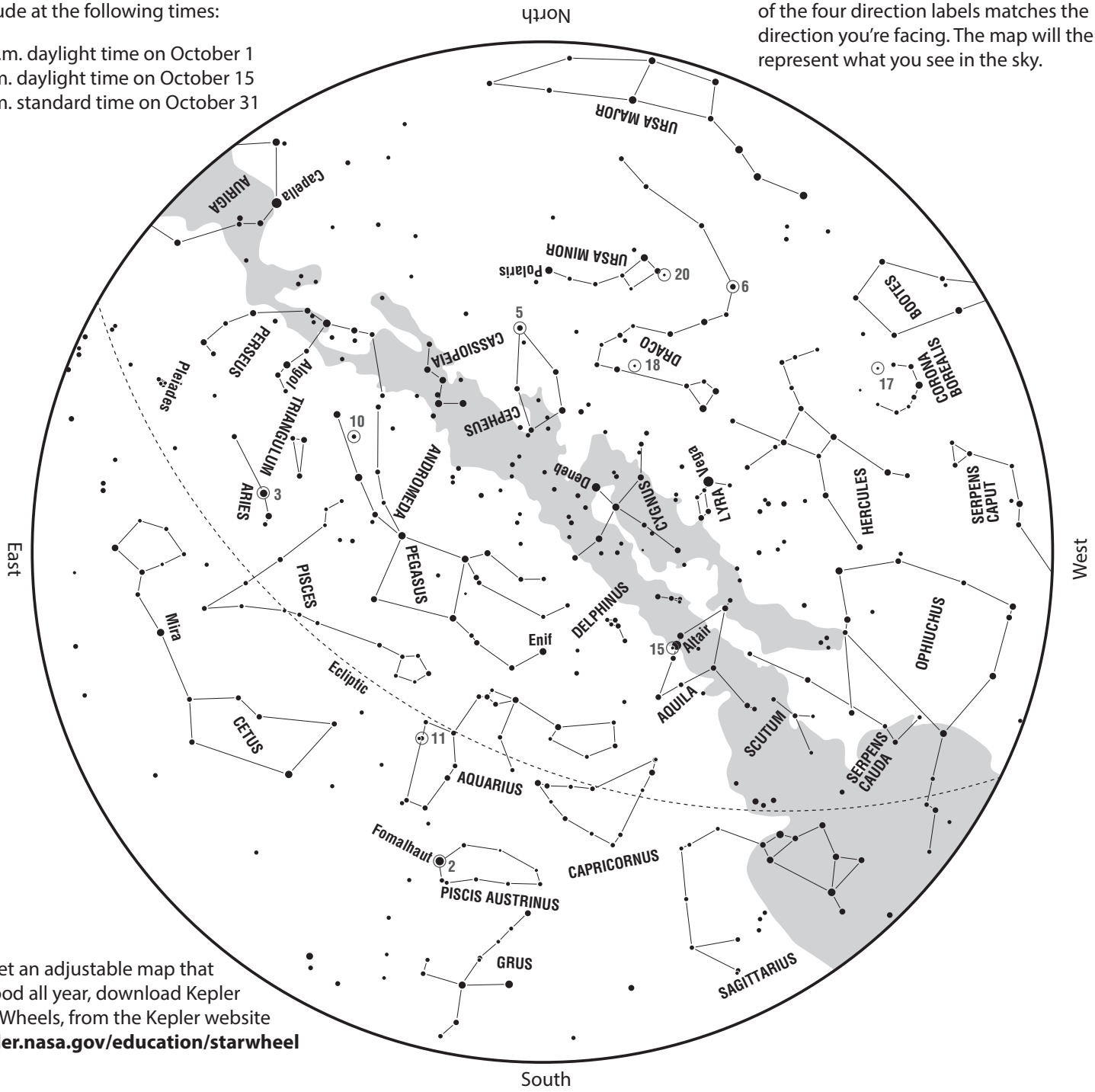
Where are the Distant Worlds?

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

10 p.m. daylight time on October 1
9 p.m. daylight time on October 15
7 p.m. standard time on October 31

October

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



To get an adjustable map that is good all year, download Kepler Star Wheels, from the Kepler website **kepler.nasa.gov/education/starwheel**

Stars visible to the unaided eye known to have planets — listed brightest to dimmest
(stars visible this month are circled and numbered on the map)

1 – Pollux (Gemini)
(2) – Fomalhaut (Piscis Austrinus)
(3) – Alpha Arietis
4 – Gamma Leonis
(5) – Gamma Cephei
(6) – Iota Draconis
7 – Epsilon Tauri
8 – Epsilon Eridani
9 – NU Canis Majoris
(10) – Upsilon Andromeda
(11) – 91 Aquarii
12 – HD 60532
13 – Tau Bootis
14 – Chi Virginis
(15) – Xi Aquilae
16 – 61 Virginis
(17) – Kappa Coronae Borealis
(18) – 42 Draconis
19 – 70 Virginis
(20) – 11 Ursae Minoris

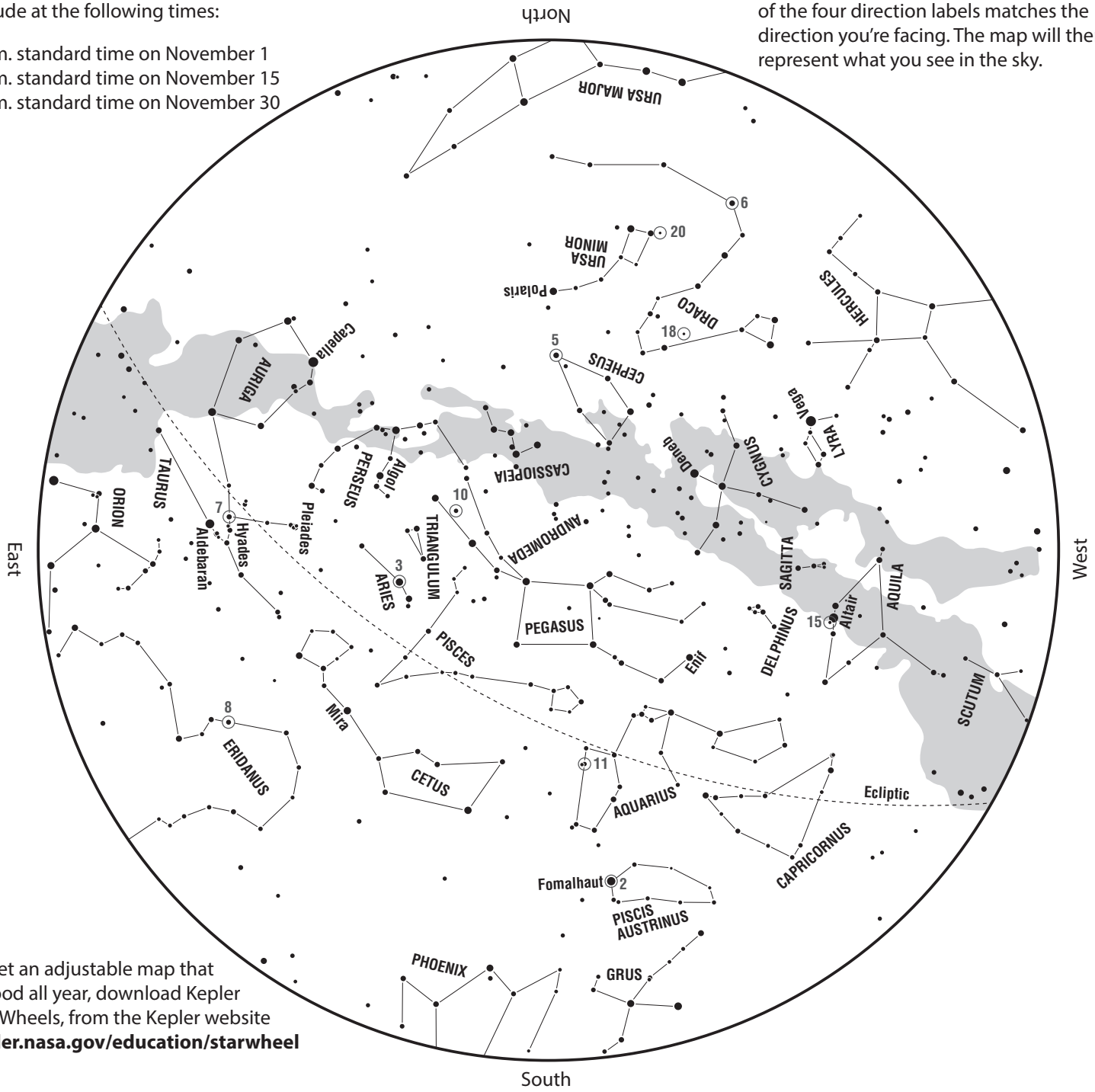
Where are the Distant Worlds?

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

9 p.m. standard time on November 1
8 p.m. standard time on November 15
7 p.m. standard time on November 30

November

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



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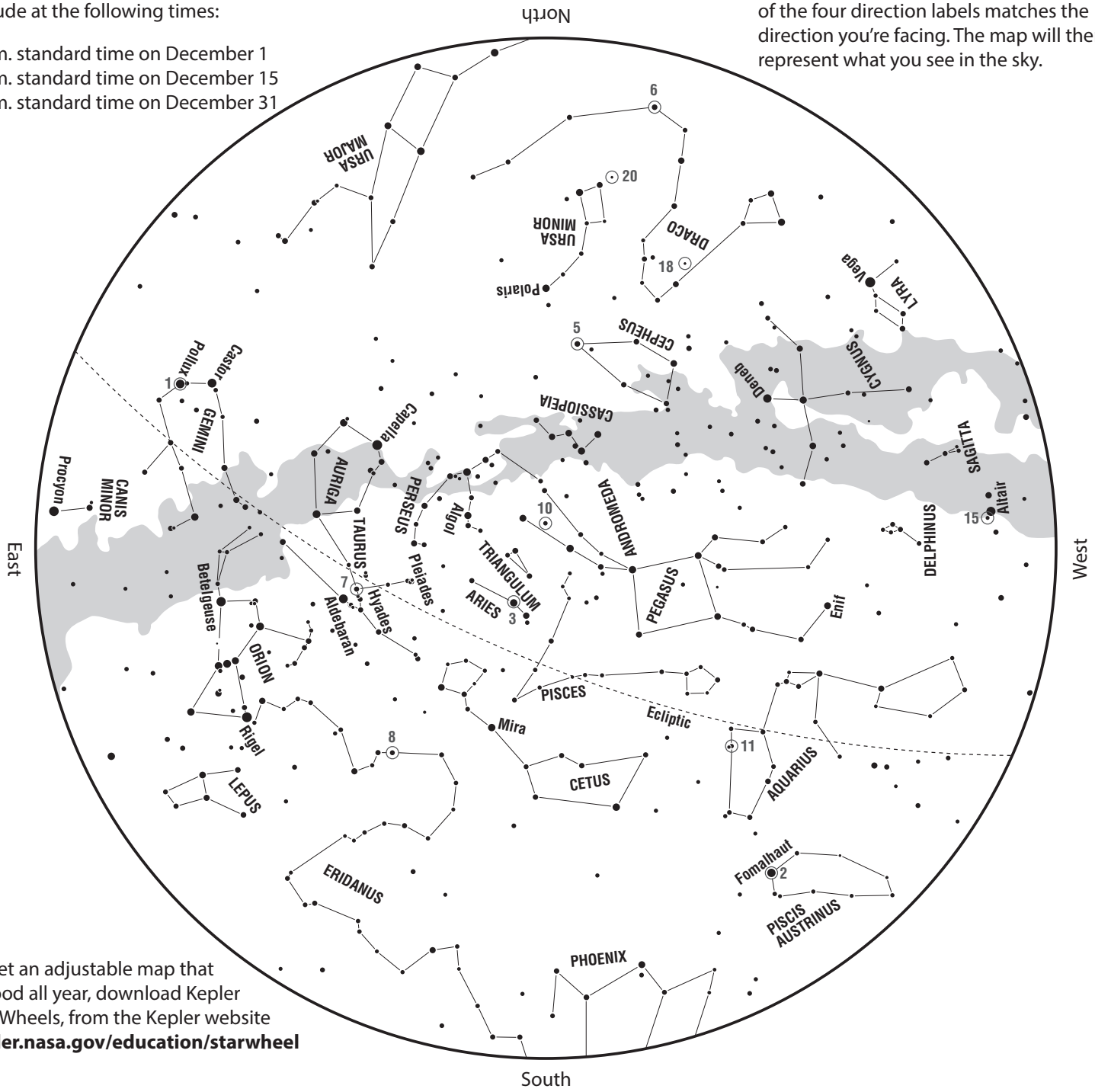
Where are the Distant Worlds?

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

9 p.m. standard time on December 1
8 p.m. standard time on December 15
7 p.m. standard time on December 31

December

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



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