WHERE ARE THE STARS?

Performance Standard 12F/11A/13A.H

Students will apply the processes of scientific inquiry to compare the view from the Earth to the galaxies accordingly:

- *Knowledge:* Understand the categories of comparisons between stars.
- *Application:* Formulate strategies for classification of stars through various physical and graphic displays.
- *Communication:* Explain the basis for classification of stars within and between various constellations.

Procedures:

1. ***In order to know and apply the concepts that explain the composition and structure of the universe and Earth's place in it (12F), and the concepts, principles and processes of scientific inquiry (11A) and know and apply the accepted practices of science (13A),*** students should experience sufficient learning opportunities to develop the following. Generate inquiry questions and eventual hypotheses which address the classification variations of stars in constellations:
   - Differentiate qualitative and quantitative astronomical data and their applicability.
   - Use conceptual, mathematical and physical models of stars within and between selected constellations.
   - Distinguish relationships of scientific models and hypotheses.
   - Interpret and represent analysis of astronomical data about constellation members.
   - Analyze research and data for supporting or refuting the selected hypotheses.
   - Report, display and defend the data analysis of constellation members and other star groupings.
   - Generate further questions for star classifications.

   Note to teacher: This activity relates to knowledge associated with standard 12F, while addressing the performance descriptors for stage H within standard 11A. Applying scientific habits of mind noted in standard 13A are applicable. The teacher and classroom resources provided for this activity are supplied with permission from Vivian Hoette, University of Chicago, Yerkes Observatory. It is suggested that each constellation's star cards should be printed onto colored stock paper according to the noted star's peak color. The cards could be laminated for reuse.
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. This activity can introduce or reinforce information about the characteristics of Stars of Winter (for the Northern Hemisphere). Randomly distribute the star cards among the students. Ask students to assemble themselves by the constellations in which their selected star is found. Ask students to focus on the individual star on their card. Ask students to propose additional arrangements for the stars they represent (other than by constellation). Color is among the most obvious of the properties, so when it is suggested, ask the students to group themselves accordingly. Constellation groups will now disperse, demonstrating that all stars in a constellation are not the same color. *This may precipitate questions or reinforce an understanding of the colors of stars. Record all student-generated questions for further individual research.* Ask for another criterion for arranging the stars. As it is also an early entry on each of the cards, students may suggest temperature. When brought up, ask students to line up in temperature order, specifying a location for the coolest and hottest stars. Students should find they have stayed within their color group, organizing by delineations of temperature. Ask students what they observe the peak color of a star is determined by its surface temperature. As students suggest other ways of arranging, have students do so, always specifying a position for the maximal and minimal values of each property. It is recommended that a couple of students who suggested the physical characteristic - distance from Earth, diameter, luminosity, apparent and absolute magnitudes be responsible for seeing the order is correct.
4. Ask students to observe the arrangements and make a hypothesis as to what the arrangements reveals about the nature of stars. Teachers can add technical information to supplement student concepts of the properties. Inquire whether the posed hypotheses match previous understanding of stars or produce somewhat contradictory ideas. This can introduce or reinforce the understanding of the relationships of scientific theories, models, hypotheses, experiments and methodologies used by scientists (accepted practices of science). Students should graphically represent their hypotheses, using models, bar/line graphs, etc., and present the analysis of their findings. Following class presentations, students should generalize their understandings about the locations and properties of the stars in the winter constellations.

5. Evaluate each student's work using the Science Rubric as follows and determine the performance level.
- *Knowledge:* The categories and bases for comparisons between stars are explained correctly and thoroughly.
- *Application:* The physical and graphic displays of selected star characteristic are portrayed accurately and comply with appropriate mathematical requirements.
- *Communication:* The basis for students' classification of stars within and between various constellations is explained thoroughly and appropriately, using the correct terms and modeling strategies.

Examples of student work not available

Time requirements: 1 class period for initial star card activity; 1-2 class period(s) for preparation of graphic display for star data groupings; 1 class period for class presentation.

Resources:
- Star cards printed on stock or construction paper (yellow, orange, white, red, light and dark blue).
- Appropriate graphing or modeling resources.
- Science rubric.

Teacher notes:

Possible hypotheses:

- that stars within a constellation can be far different than or similar to others stars in that grouping,
- that stars that appear close in the sky can actually be huge (astronomical) distances from each other and from Earth,
- that apparent magnitude is a function of distance from Earth - the greater the distance, the lesser the magnitude and vice versa, so the sun has a large apparent magnitude,
- that absolute magnitude is a function of luminosity, so the sun is, by comparison, a star of low luminosity (it can be explained that absolute magnitude is based on placing all stars an imaginary 33 light years from Earth),
- that levels of magnitude are like golf scores; the smaller the value (or larger the absolute value of a negative integer) the greater the magnitude of that star; conversely, the larger the value of a positive integer, the lesser the intensity), and
- that size of star is a function of luminosity.

Possible extension activities:

- Study summer constellations not included in the star cards. Students can produce star cards of similar format to those used in class, including attaching to appropriately-colored paper. Pre-investigation of internet or library resources by teacher will minimize a lack of information available to some students. Constellation groups present their findings with a diagram of the star formation (holes punched in dark paper for display on an overhead projector). Individual presenters should compare their star to sun or other well-known star such as Polaris to demonstrate understanding of the physical properties of stars. For example, a presenter can say the star has an apparent magnitude about four times that of the sun or 1/4 that of Polaris, or that their star is about half the distance from the Earth as another star.

- Create a personal, albeit imaginary, constellation and apply knowledge to that grouping. Start by using a grid of graphing paper, with letters in alphabetical order along one axis, letters of their name in spelling order along the other. Students poke through grid squares where each name letter matches the alphabetical letter. Students then transfer this template of holes to marks on a piece of construction paper and appropriately-sized sticker stars are placed on these marks. Students then create a figure or shape that encompasses the pattern of stars, but is not a "connect-the-dots" puzzle. They then name their constellation, based on their name or the shape they have chosen. The presenting student then chooses a star in the design and creates imaginary data for this star. Their presentation, however, must reflect an understanding of the physical properties of stars. For example, if the chosen star has a Kelvin temperature of 10,000, acquired knowledge should lead the student to say it is probably a blue-white body; distant stars should have high value apparent magnitude (meaning "being less visible in the sky"); greatly luminous stars should have a low value (or even negative value) absolute magnitude.

Among the Stars of Winter

Star Cards and Lesson Plan by Vivian Hoette

LEVEL Third through tenth grade students.

INSTRUCTIONAL ARRANGEMENT There should be open space (a hallway or an open area in the classroom, etc.) for students to form groups or lines.

RATIONALE Personalizing star information allows students to understand physical characteristics of stars in a familiar way, associating individual stars with members of the student group and sorting stars while sorting the people who have the information about those stars on cards.

LENGTH Twenty minutes or more depending on teacher's objectives and students' interests. Star cards may be used on several occasions or with different grade levels depending on lesson objectives.

OBJECTIVES

- Students will learn that stars vary in: color, brightness, true size and luminosity, distance from Earth, temperature, etc. Stars are identified by their place within a constellation pattern.
- Students will learn that the peak color in a star's light is related to the star's surface temperature.
- Students will learn that most of the stars we see in the night sky are bigger and brighter than the sun.
- Using star data as a source of comparison and classification, students will practice classification, ordering, and application of numerical skills involving positive and negative numbers, the number line, decimals to the hundredth place, and number names up to hundreds of thousands.
- Students will become familiar with star and constellation names and historic constellation figures.

MATERIALS and PREPARATION

1. Cut apart the star cards of the forty or so named stars belonging to constellations of the Winter Circle (Orion, Lepus, Canis Major, Canis Minor, Gemini, Auriga, and Taurus).
2. Mount the cards on red, orange, yellow, white, blue-white, or blue construction paper to match the peak color of each star's spectrum. Laminate the cards.
3. Use a marker to write the name of the star and its constellation in large letters on the back of the card. Use uppercase for the first letter and lower case for the remaining letters of the star's name. Use all uppercase for the name of the constellation.

PROCEDURE

Engage Student Interest

- Ask students to observe the night sky on a clear evening or view constellation slides in class. Invite the students to sketch, share and discuss their observations.
- Randomly drop stars of different colors and sizes onto dark construction paper. Ask students to glue down the stars, create drawings around them, and tell or write stories about the drawings.

Allow Students to Explore and Classify Stars

1. Let students select a particular star card or pass cards out randomly. (Some teachers use the cards as basis for cooperative group arrangements.)
2. Ask students to study the information on the cards. Give them time to look over the cards and compare the information on their card with information on the cards of their classmates.
3. Ask the group if anyone has an idea about how these stars could be organized. (As we look at the stars in the night sky, they seem 'stuck' in their constellations. In this activity students are able to arrange and rearrange stars according to their apparent and physical properties.)
4. As different ideas are suggested, encourage the person who presented the idea to organize the people in the class (each being a different star) to form groups or lines illustrating the plan suggested. Encourage student leadership.

Vivian L. Hoette, Education Outreach Coordinator
The University of Chicago Yerkes Observatory
373 West Geneva Street, Williams Bay, WI 53191
Tel: (262) 245-5555 Fax: (262) 245-9805 Email: vhoette@hale.yerkes.uchicago.edu

Explain Astronomy Concepts

Discuss the astronomy concepts and content of the various data fields presented on the cards as students suggest ways to organize the stars.

Star Names: The names of stars are very old. Meanings that do not make sense when looking at the constellation drawings may give clues to the origination of names from earlier cultures who have imagined different pictures in the stars and told different stories. Often star names refer to significant rising and setting times, seasonal and meteorological events, as well as to imaginary figures.

Identification: On constellation drawings, brighter stars are identified by Greek letters assigned by Johann Bayer in 1601. These stars are identified by the Greek letter and the constellation name in the Latin genitive case; this identification is given in its abbreviated and entire form.

Distance: Distance in space is measured in light-years. One **light-year** is the distance light travels in a year, about 9.5 trillion kilometers or about 6 trillion miles.

Peak Color: Starlight is studied by spectroscopy (using diffraction to break light into its component colors). Depending on how hot a star is, the light emitted from the star shines brightest in certain wavelengths. Stars whose spectra peak in the red are cooler than stars whose spectra peak in the blue.

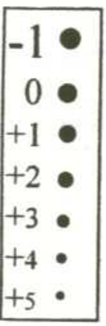
Temperature in Kelvins: This is the surface temperature of the star. When one organizes the stars by surface temperature, one also sees the relationship of peak color to temperature.

Astronomers use the Kelvin scale. Scale changes in Kelvin (K) are equivalent to those in Celsius; the difference is the placement of zero. Absolute zero in Kelvin is 0 K; absolute zero in Celsius is -273.150 degrees. Freezing in Kelvin is 273.150 K; freezing in Celsius is 0 degrees. Boiling in Kelvin is 373.150 K; boiling in Celsius is 100 degrees. One reads the temperature in the Kelvin scale as so many Kelvins rather than using the word degrees as with the Celsius or Fahrenheit scales.

Star's Class (called Luminosity Class by astronomers): The stage of the star's 'life' cycle. Most stars spend most of their existence in the main sequence phase. Later, stars enlarge dramatically to become giant or supergiant stars. Finally, most stars shrink to become white, red, or black dwarfs. Some stars explode as supernovae while their cores collapse into extremely dense neutron stars or black holes.

Diameter: Width of the star, as compared to the sun.

Luminosity: Total light energy emitted by the star, as compared to the sun.



Magnitude Scales: A measure of the brightness of a star. The magnitude scale is logarithmic (2.5 times the brightness between consecutive numbers). Our eyes see light logarithmically. Magnitudes describe brightness inversely so that smaller numbers indicate brighter stars; zero and negative numbers indicate still greater brightness.

Apparent Magnitude: How bright the star <u>appears or seems</u> to be as we observe it from Earth. The system was first set up ages ago with a scale of one to six. One was for the brightest stars and six was for the faintest stars that people could see. Since that time, we have been able to measure the brightness of stars more accurately. The apparent magnitude scale now extends to zero and negative numbers for the very brightest stars.

Absolute Magnitude: True or intrinsic brightness of a star; this scale measures the stars as if they were all the same distance away (about 32.6 light years).

Spectral Type: Spectral classifications are O, B, A, F, G, K, and M. O stars are the hottest and M stars are the coolest. Luminosity class is indicated by Roman numerals. I is supergiant: II is bright giant; III is giant; IV is subgiant; and V is main sequence. Spectral and luminosity classes are further subdivided with numbers and letters.

Constellation Drawings: The drawings of Auriga, Canis Major, Canis Minor, Gemini, and Orion are adapted from Johann Bode, 1801. The drawing of Taurus is adapted from John Bevis (based on Bayer), 1750. The drawing of Lepus is adapted from Pardies.

Enhance Student Interest

- Plan a field trip for your students to the Adler Planetarium or a planetarium near your school.
- Arrange to bring a portable planetarium to your school.
- Plan a star party inviting an amateur astronomer to bring a telescope to your school in the evening.
- Use diffraction gratings or prisms to analyze various sources of light.
- Visit the library to find books on astronomy and constellations. Research constellation stories.

Evaluate Students' Understanding.

- Give individuals or small groups of students a subset of the star cards and ask them to organize and group the stars by various criteria. Ask students to explain their classification systems.
- Ask individuals or groups to brainstorm all the ways stars are different from each other and the ways stars are alike. Do this as both a pre and post evaluation of students' ideas about stars.
- Use the **KWL** (**K**now?, **W**ant to know? **L**earned?) method. What do you already know about stars? What do you want to know about stars? as questions to pose to students before the activity. After the activity ask students to write or discuss what they have learned about stars.

ABOUT THE DATABASE

The physical star data used for this set of cards was drawn from StarList 2000 by Richard Dibon-Smith who also provided updated data regarding Alnitak, Betelgeuse, Mebsuta, and Saiph. The temperature values were determined by the author using a variety of methods. Star data varies widely depending on the reference work one is using. Conflicting data results as astronomers learn more about stars, refer to different data sets or use different methods of analyzing data. The author accepts full responsibility for errors not accounted for by the range of values found in the available astronomical reference works.

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Among the Stars of Winter Database

Star Name	Pronunciation Key	Abbreviated Identification	Greek Letter Name + Constellation Genitive	Distance in Light-years	Peak Color in Spectrum
Capella	kah-PELL-ah	α Aur	Alpha Aurigae	44	yellow
Menkalinan	men-CALL-ih-nan	β Aur	Beta Aurigae	80	blue-white
Almaaz	al-MAAZ	ε Aur	Epsilon Aurigae	6,500	white
Hoedus II	HEE-dus 2	η Aur	Eta Aurigae	310	blue
Hassaleh	hah-SAW-leh	ι Aur	Iota Aurigae	330	orange
Theta Auriga	THAY-tah Auriga	θ Aur	Theta Aurigae	150	blue-white
Hoedus I	HEE-dus 1	ζ Aur	Zeta Aurigae	530	orange
Sirius	SEAR-eh-us	α CMa	Alpha Canis Majoris	9	blue-white
Mirzam	MERE-zam	β CMa	Beta Canis Majoris	740	blue
Wezen	WE-zen	δ CMa	Delta Canis Majoris	3,100	white
Adhara	a-DAY-rah	ε CMa	Epsilon Canis Majoris	490	blue
Muliphen	moo-li-FAYN	γ CMa	Gamma Canis Majoris	1,000	blue
Aludra	ah-LUD-rah	η CMa	Eta Canis Majoris	2,500	blue
Furud	FOU-rude	ζ CMa	Zeta Canis Majoris	290	blue
Procyon	PRO-seh-on	α CMi	Alpha Canis Minoris	11	white
Gomeisa	go-MY-za	β CMi	Beta Canis Minoris	140	blue
Castor	CASS-ter	α Gem	Alpha Geminorum	47	blue-white
Pollux	PAUL-lucks	β Gem	Beta Geminorum	35	orange
Wasat	WAY-sat	δ Gem	Delta Geminorum	53	white
Mebsuta	meb-SUE-tah	ε Gem	Epsilon Geminorum	190	yellow
Alhena	al-HEN-ah	γ Gem	Gamma Geminorum	88	blue-white
Propus	PRO-puss	η Gem	Eta Geminorum	190	red
Tejat Posterior	TAY-got posterior	μ Gem	Mu Geminorum	160	red
Alzirr	al-ZEER	ξ Gem	Xi Geminorum	59	white
Mekbuda	mek-BOO-dah	ζ Gem	Zeta Geminorum	1,500	yellow
Arneb	ARE-neb	α Lep	Alpha Leporis	930	white
Nihal	HIGH-al	β Lep	Beta Leporis	320	yellow
Betelgeuse	BET-el-jooz	α Ori	Alpha Orionis	325	red
Rigel	RYE-jel	β Ori	Beta Orionis	910	blue
Mintaka	min-TAH-kah	δ Ori	Delta Orionis	2,300	blue
Alnilam	al-NIGH-lam	ε Ori	Epsilon Orionis	1,200	blue
Bellatrix	beh-LAY-trix	γ Ori	Gamma Orionis	360	blue
Algiebba	al-GABE-bah	η Ori	Eta Orionis	770	blue
Nair al Saif	NAIR al-SIGH-f	ι Ori	Iota Orionis	1,900	blue
Saiph	SAFE	κ Ori	Kappa Orionis	215	blue
Meissa	my-SAH	λ Ori	Lambda Orionis	470	blue
Alnitak	al-NIGH-tak	ζ Ori	Zeta Orionis	1,600	blue
Aldebaran	al-DEB-ah-ran	α Tau	Alpha Tauri	65	orange
El Nath	EL-nath	β Tau	Beta Tauri	150	blue
Ain	EYE-n	ε Tau	Epsilon Tauri	150	yellow
Al Hecka	al-HECK-a	ζ Tau	Zeta Tauri	520	blue
Alcyone	al-SIGH-oh-nee	η Tau	Eta Tauri	260	blue
Sun		Distance from Earth is 8.3 light-minutes			yellow

Among the Stars of Winter Database

Star Name	Greek Letter	Star's Luminosity Class	Temperature in Kelvins (K)	Diameter in Suns	Luminosity in Suns	Apparent Magnitude	Absolute Magnitude	Spectral Type
Capella	α	giant	5,100	11	72	0.08	0.09	G8 III
Menkalinan	β	subgiant	9,000	2	45	1.90 variable	0.6	A2 IV
Almaaz	ε	supergiant	7,200	365	200,000	2.99 variable	-8.5	F0 Ia
Hoedus II	η	main sequence	21,000	3	377	3.17	-1.7	B3 V
Hassaleh	ι	bright giant	4,200	73	655	2.69	-2.3	K3 II
Theta Auriga	θ	peculiar	10,000	2	146	2.62 variable	-0.7	A0 pec
Hoedus I	ζ	bright giant	4,300	53	655	3.75 variable	-2.3	K4 II
Sirius	α	main sequence	9,700	2	21	-1.46	1.42	A1 V
Mirzam	β	bright giant	26,000	4	6,500	1.98 variable	-4.8	B1 II
Wezen	δ	supergiant	6,000	365	125,000	1.86	-8.0	F8 Ia
Adhara	ε	bright giant	20,000	5	4,500	1.50	-4.4	B2 II
Muliphen	γ	bright giant	14,000	5	1,803	4.11	-3.4	B8 II
Aludra	η	supergiant	14,500	37	50,000	2.44	-7.0	B5 Ia
Furud	ζ	main sequence	18,000	2	377	3.02	-1.7	B2.5 V
Procyon	α	subgiant	6,700	2	7	0.38	2.64	F5 IV
Gomeisa	β	main sequence	13,000	2	95	2.90 variable	-0.2	B8 Ve
Castor	α	main sequence	9,300	2	28	1.58	1.14	A1 V
Pollux	β	giant	4,900	9	32	1.14	0.98	K0 IIIb
Wasat	δ	subgiant	7,000	2	8	3.53	2.46	F2 IV
Mebsuta	ε	supergiant	5,000	33	175	2.98	-0.9	G8 Ib
Alhena	γ	subgiant	9,800	3	79	1.93	0	A0 IV
Propus	η	giant	3,100	34	125	3.28 variable	-0.5	M3 III
Tejat Posterior	μ	giant	2,900	35	125	2.88 variable	-0.5	M3 IIIa
Alzirr	ξ	giant	6,600	2	11	3.36	2.1	F5 III
Mekbuda	ζ	supergiant	5,700	86	5,000	3.79 variable	-4.5	G0 Ib
Arneb	α	supergiant	7,400	32	6,000	2.58	-4.7	F0 Ib
Nihal	β	bright giant	5,600	30	545	2.84	-2.1	G5 II
Betelgeuse	α	supergiant	3,400	265	5,000	0.50 variable	-4.5	M1 Iab
Rigel	β	supergiant	13,000	58	55,000	0.12	-7.1	B8 Iac
Mintaka	δ	giant	24,000	13	50,000	2.23 variable	-7.0	B0 III
Alnilam	ε	supergiant	23,000	16	25,000	1.70 variable	-6.2	B0 Iae
Bellatrix	γ	giant	23,000	3	2,168	1.64	-3.6	B2 III
Algiebba	η	main sequence	19,000	8	1,977	3.36 variable	-3.5	B1 V
Nair al Saif	ι	giant	28,000	6	20,000	2.77	-6.0	O9 III
Saiph	κ	supergiant	22,000	4	525	2.06	-2.1	B0.5 Ia
Meissa	λ	not indentified	35,000	3	552	3.66	-2.2	O8 e
Alnitak	ζ	supergiant	28,000	80	34,000	2.05	-6.6	O9.5 Ib
Aldebaran	α	giant	4,000	34	137	0.85 variable	-0.6	K5 III
El Nath	β	giant	14,000	2	344	1.65	-1.6	B7 III
Ain	ε	giant	5,000	13	65	3.53	0.2	G9.5III
Al Hecka	ζ	giant	18,000	4	1247	3.00	-3.0	B4 III
Alcyone	η	giant	15,000	3	344	2.87	-1.6	B7 III
Sun		main sequence	5,800	1	1	-26.72	4.74	G2 V

Among the Stars of Winter Database

Star Name	Significance of Star Name
Capella	little she-goat, goat star, rainy goat star
Menkalinan	shoulder of the rein holder
Almaaz	he-goat; western goat star; signal for close of navigation; also called Al Anz
Hoedus II	one of kid goats, rising before Sun marks stormy season
Hassaleh	marks back of charioteer's knee
Theta Auriga	marks wrist of charioteer
Hoedus I	one of kid goats; rising before Sun marks stormy season; also called Sadatoni
Sirius	sparkling; dog star; scorching one; rising before Sun on hottest days of summer
Mirzam	roarer or announcer (of Sirius)
Wezen	weight; also called Wesen
Adhara	maiden, attendant of Suhail who married Orion
Muliphen	marks the top of the dog's head
Aludra	maiden, attendant of Suhail who married Orion
Furud	male apes, also called Phurud
Procyon	before the dog (rising before Sirius), water dog (near Milky Way)
Gomeisa	watery eyed (near Milky Way), also called Mirzam
Castor	horseman, mortal twin
Pollux	boxer, immortal twin
Wasat	middle of the sky (near the ecliptic)
Mebsuta	outstretched paw of the lion
Alhena	brand mark
Propus	the projecting foot; also called Tejat Prior
Tejat Posterior	heel
Alzirr	button
Mekbuda	folded paw of the lion
Arneb	the hare
Nihal	camels quenching their thirst
Betelgeuse	arm of central one; armpit of white belted sheep
Rigel	left leg of giant, Orion's left foot
Mintaka	belt
Alnilam	string of pearls
Bellatrix	Amazon female warrior
Algiebba	handle of the sword
Nair al Saif	bright one of the sword
Saiph	sword of powerful one
Meissa	glittering star
Alnitak	girdle
Aldebaran	follower (of the Pleiades)
El Nath	the one butting with horns
Ain	eye
Al Hecka	white one
Alcyone	brightest one of the Pleiades (Seven Sisters)

Star: Rigel *RYE-jel*

left leg of giant, Orion's left foot

Identification: β Ori *Beta Orionis*

Distance from Earth: 910 light-years

Peak Color: blue

Temperature in Kelvins: 13,000 K

Star's Class: supergiant

Diameter: 58 solar diameters

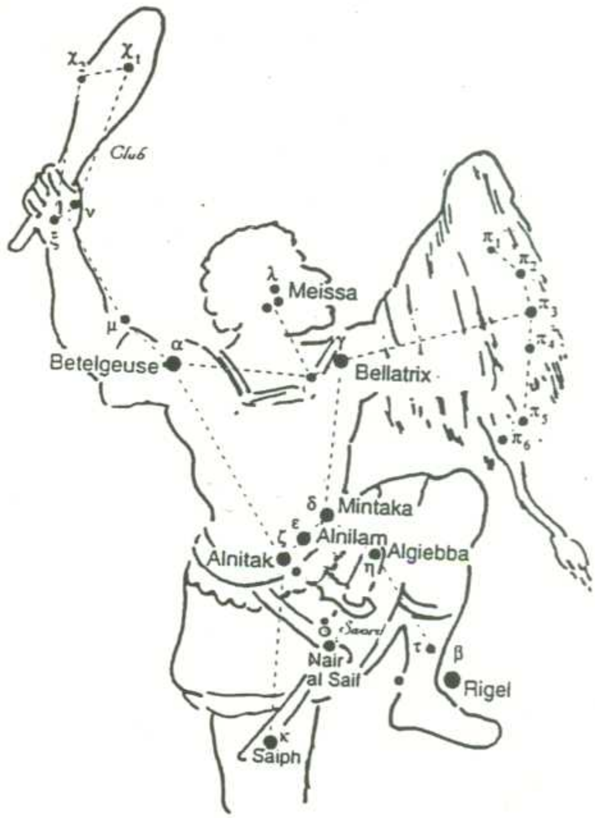
Luminosity: 55,000 times Sun's brightness

Apparent Magnitude: +0.12

Absolute Magnitude: -7.1

Spectral Type: B8 Iac

Constellation: ORION *oh-RYE-un* HUNTER



Star: Alnitak *al-NIGH-tak*

girdle

Identification: ζ Ori *Zeta Orionis*

Distance from Earth: 1,600 light-years

Peak Color: blue

Temperature in Kelvins: 28,000 K

Star's Class: supergiant

Diameter: 80 solar diameters

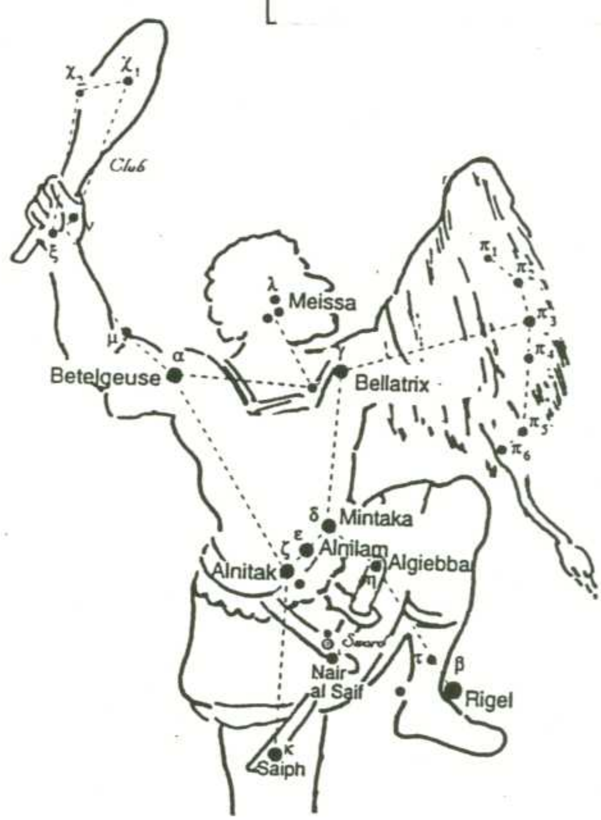
Luminosity: 34,000 times Sun's brightness

Apparent Magnitude: +2.05

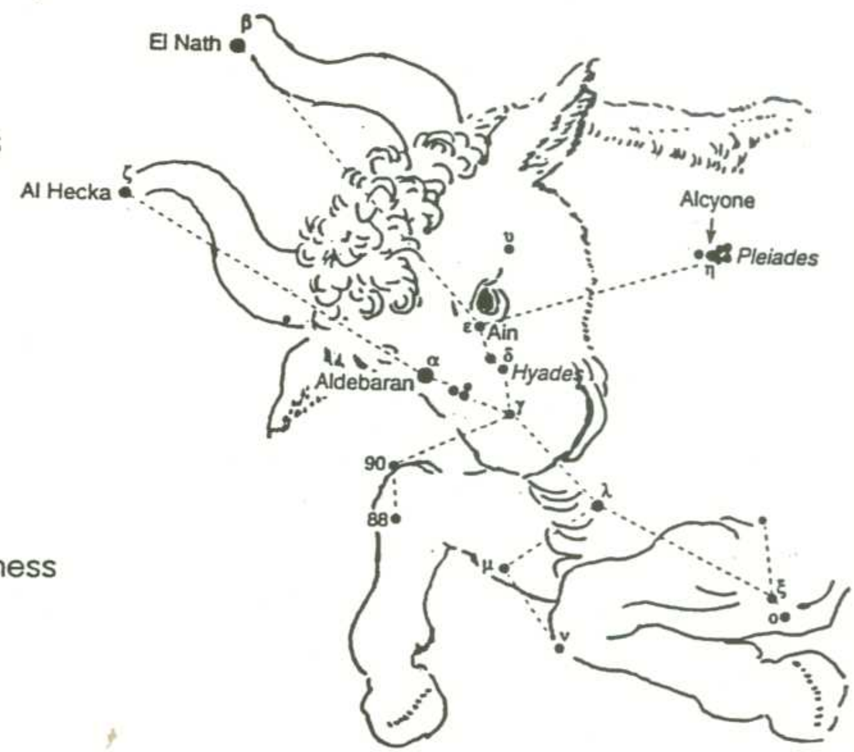
Absolute Magnitude: -6.6

Spectral Type: O9.5 Ib

Constellation: ORION *oh-RYE-un* HUNTER



Star: Alcyone *al-SIGH-oh-nee*
brightest one of the Pleiades (Seven Sisters)



Identification: η Tau *Eta Tauri*

Distance from Earth: 260 light-years

Peak Color: blue

Temperature in Kelvins: 15,000 K

Star's Class: giant

Diameter: 3 solar diameters

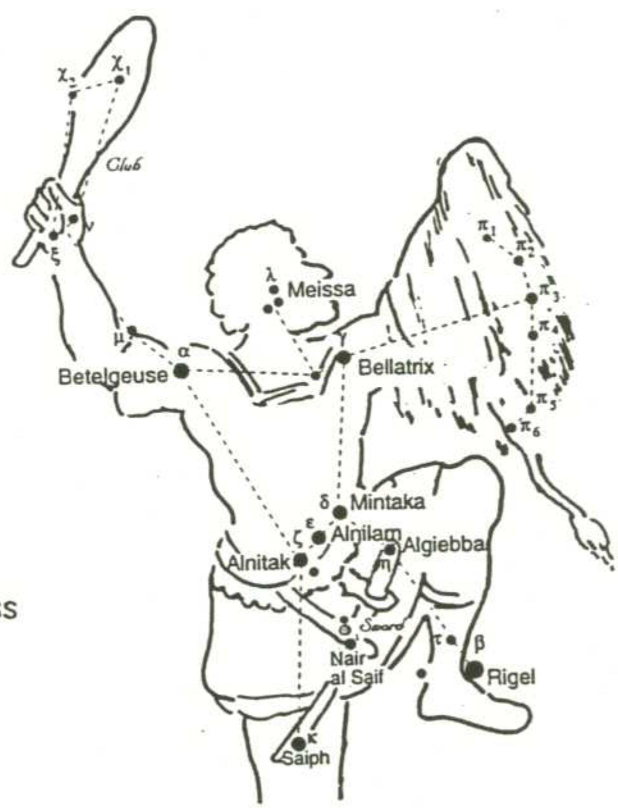
Luminosity: 344 times Sun's brightness

Apparent Magnitude: +2.87

Absolute Magnitude: -1.6

Spectral Type: B7 III **Constellation:** TAURUS *TAW-russ* BULL

Star: Mintaka *min-TAH-kah*
belt



Identification: δ Ori *Delta Orionis*

Distance from Earth: 2,300 light-years

Peak Color: blue

Temperature in Kelvins: 24,000 K

Star's Class: giant

Diameter: 13 solar diameters

Luminosity: 50,000 times Sun's brightness

Apparent Magnitude: +2.23 variable

Absolute Magnitude: -7.0

Spectral Type: B0 III **Constellation:** ORION *oh-RYE-un* HUNTER

Star: **Saiph** *SAFE*
sword of powerful one

Identification: κ Ori *Kappa Orionis*

Distance from Earth: 215 light-years

Peak Color: blue

Temperature in Kelvins: 22,000 K

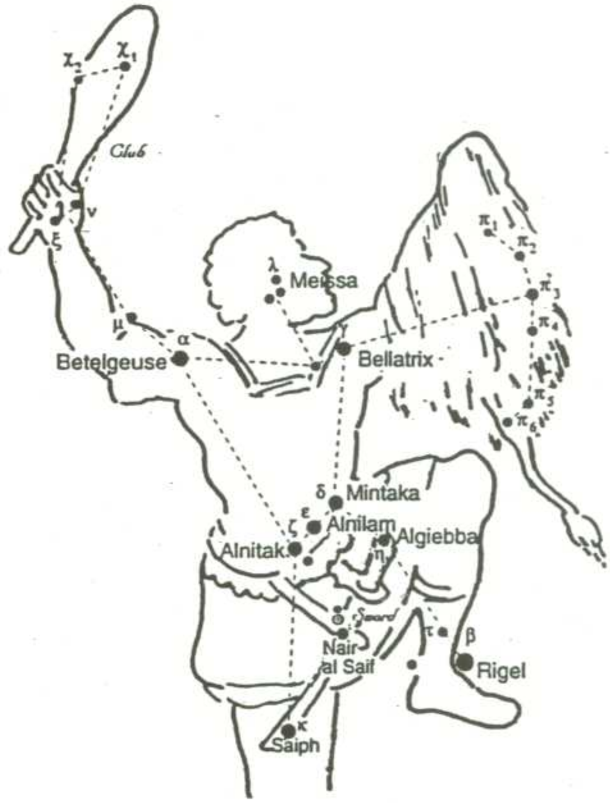
Star's Class: supergiant

Diameter: 4 solar diameters

Luminosity: 525 times Sun's brightness

Apparent Magnitude: +2.06

Absolute Magnitude: -2.1



Spectral Type: B0.5 Ia

Constellation: **ORION** *oh-RYE-un* **HUNTER**

Star: **Algiebba** *al-GABE-bah*
handle of the sword

Identification: η Ori *Eta Orionis*

Distance from Earth: 770 light-years

Peak Color: blue

Temperature in Kelvins: 19,000 K

Star's Class: main sequence

Diameter: 8 solar diameters

Luminosity: 1,977 times Sun's brightness

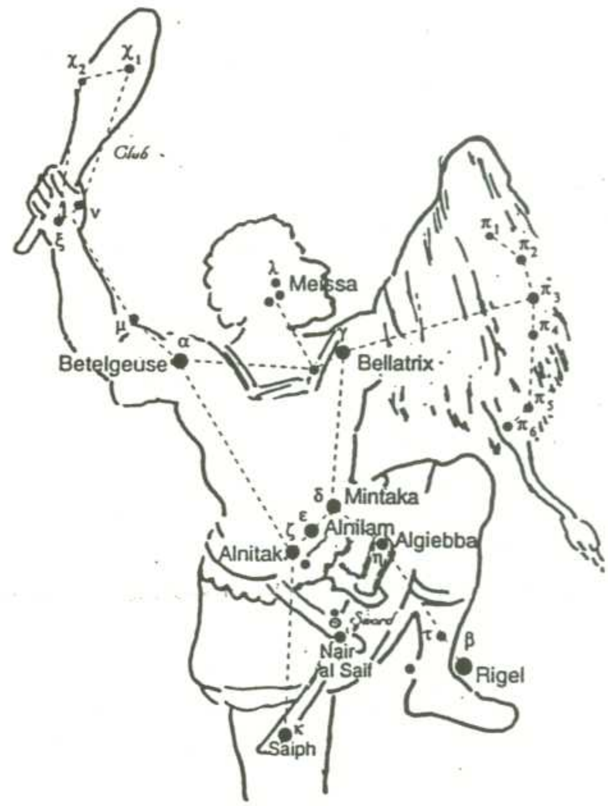
Apparent Magnitude: +3.36 variable

Absolute Magnitude: -3.5

Spectral Type: B1 V

Constellation: **ORION** *oh-RYE-un* **HUNTER**

Star: **Alnilam** *al-NIGH-lam*
string of pearls



Identification: ε Ori *Epsilon Orionis*

Distance from Earth: 1,200 light-years

Peak Color: blue

Temperature in Kelvins: 23,000 K

Star's Class: supergiant

Diameter: 16 solar diameters

Luminosity: 25,000 times Sun's brightness

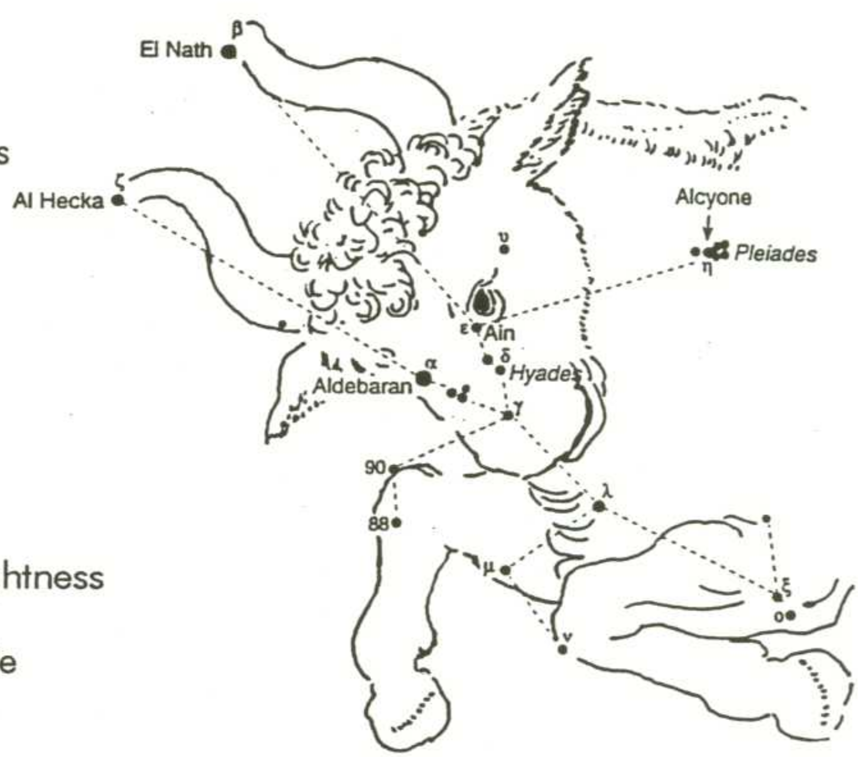
Apparent Magnitude: +1.70 variable

Absolute Magnitude: -6.2

Spectral Type: B0 Iae

Constellation: **ORION** *oh-RYE-un* HUNTER

Star: **Al Hecka** *al-HECK-a*
the white one



Identification: ζ Tau *Zeta Tauri*

Distance from Earth: 520 light-years

Peak Color: blue

Temperature in Kelvins: 18,000 K

Star's Class: giant

Diameter: 4 solar diameters

Luminosity: 1,247 times Sun's brightness

Apparent Magnitude: +3.00 variable

Absolute Magnitude: -3.0

Spectral Type: B4 III

Constellation: **TAURUS** *TAW-russ* BULL

Star: **Meissa** *my-SAH*
glittering star

Identification: **λ Ori** *Lambda Orionis*

Distance from Earth: 470 light-years

Peak Color: blue

Temperature in Kelvins: 35,000 K

Star's Class: not indentified

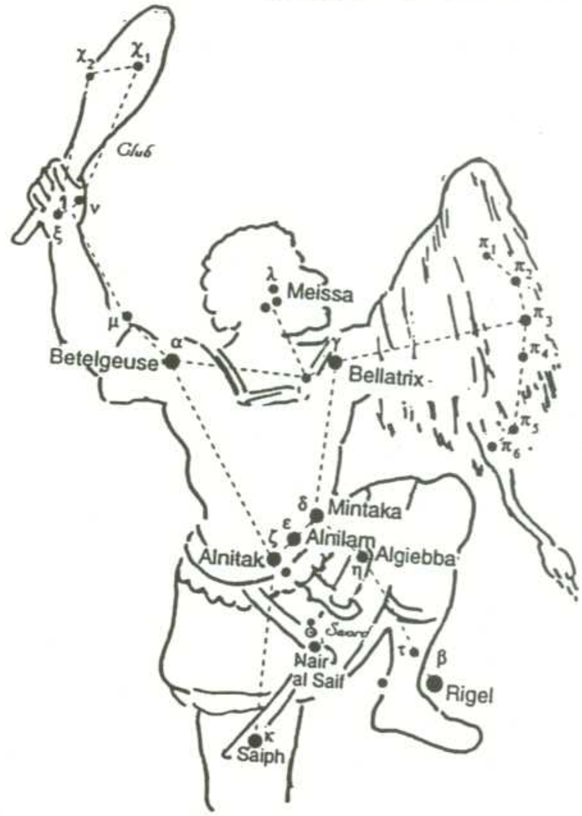
Diameter: 3 solar diameters

Luminosity: 552 times Sun's brightness

Apparent Magnitude: +3.66

Absolute Magnitude: -2.2

Spectral Type: O8 e



Constellation: **ORION** *oh-RYE-un* **HUNTER**

Star: **Nair al Saif** *NAIR al-SIGH-f*
bright one of the sword

Identification: **ι Ori** *Iota Orionis*

Distance from Earth: 1,900 light-years

Peak Color: blue

Temperature in Kelvins: 28,000 K

Star's Class: giant

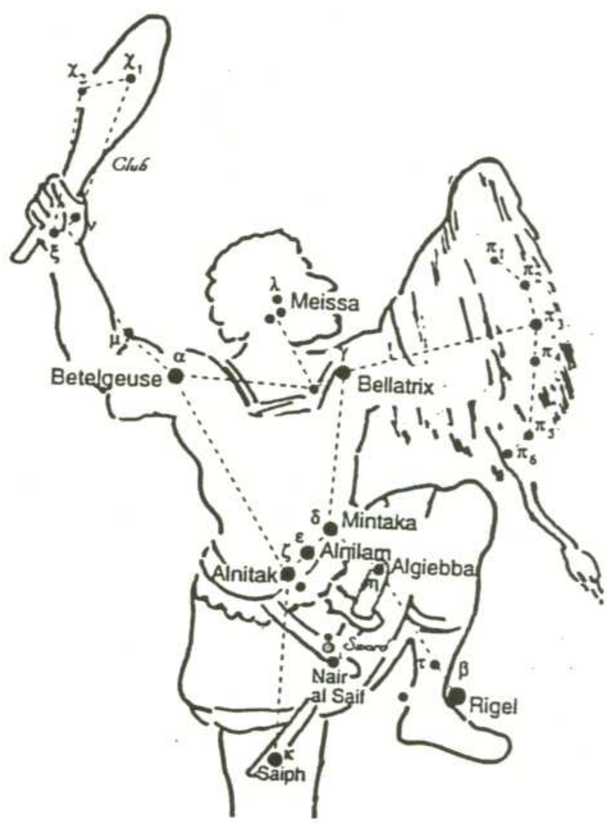
Diameter: 6 solar diameters

Luminosity: 20,000 times Sun's brightness

Apparent Magnitude: +2.77

Absolute Magnitude: -6.0

Spectral Type: O9 III



Constellation: **ORION** *oh-RYE-un* **HUNTER**

Star: Mirzam *MERE-zam*
roarer or announcer (of Sirius)

Identification: β CMa *Beta Canis Majoris*

Distance from Earth: 740 light-years

Peak Color: blue

Temperature in Kelvins: 26,000 K

Star's Class: bright giant

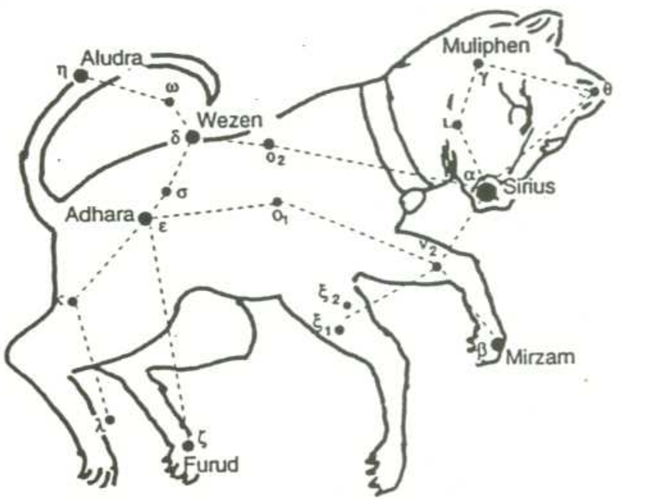
Diameter: 4 solar diameters

Luminosity: 6,500 times Sun's brightness

Apparent Magnitude: +1.98 variable

Absolute Magnitude: -4.8

Spectral Type: B1 II



Constellation: CANIS MAJOR *KAY-nis MAY-jer* BIG DOG

Star: Hoedus II *HEE-dus 2*
one of kid goats, rising before Sun marks stormy season

Identification: η Aur *Eta Aurigae*

Distance from Earth: 310 light-years

Peak Color: blue

Temperature in Kelvins: 21,000 K

Star's Class: main sequence

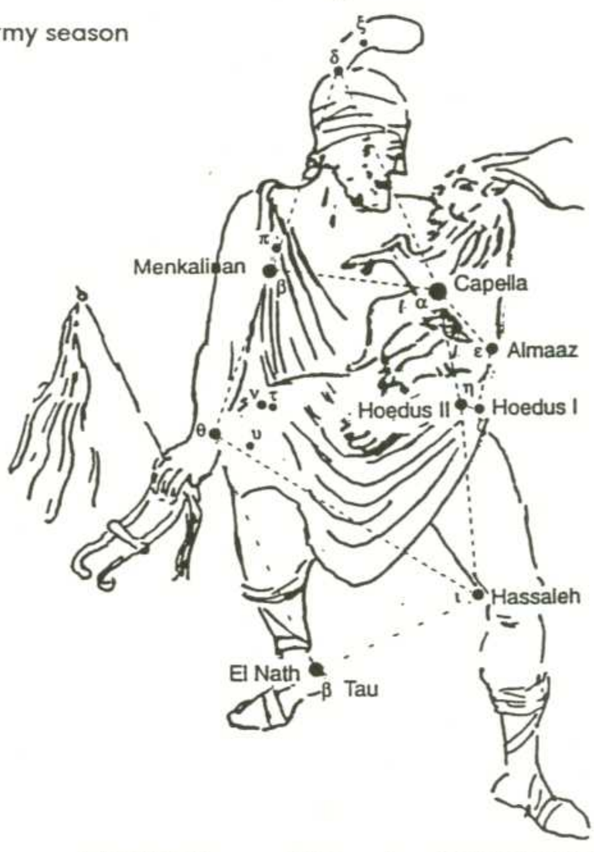
Diameter: 3 solar diameters

Luminosity: 377 times Sun's brightness

Apparent Magnitude: +3.17

Absolute Magnitude: -1.7

Spectral Type: B3 V



Constellation: AURIGA *au-RYE-gah* CHARIOTEER

Star: Adhara *a-DAY-rah*
maiden, attendant of Suhail who married Orion

Identification: ε CMa *Epsilon Canis Majoris*

Distance from Earth: 490 light-years

Peak Color: blue

Temperature in Kelvins: 20,000 K

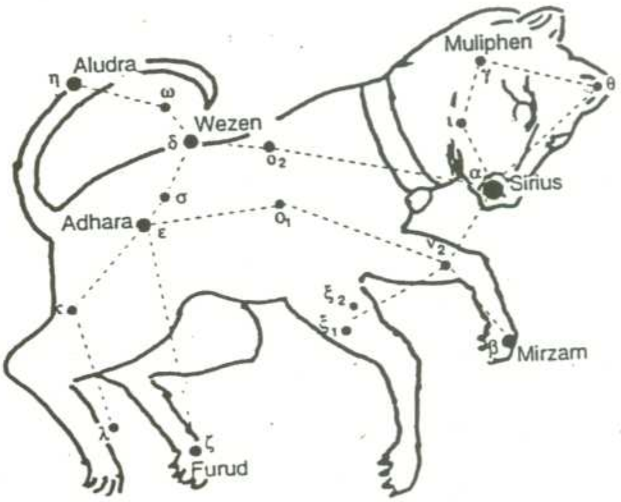
Star's Class: bright giant

Diameter: 5 solar diameters

Luminosity: 4,500 times Sun's brightness

Apparent Magnitude: +1.50

Absolute Magnitude: -4.4



Spectral Type: B2 II **Constellation:** CANIS MAJOR *KAY-nis MAY-jer* BIG DOG

Star: Aludra *ah-LUD-rah*
maiden, attendant of Suhail who married Orion

Identification: η CMa *Eta Canis Majoris*

Distance from Earth: 2,500 light-years

Peak Color: blue

Temperature in Kelvins: 14,500 K

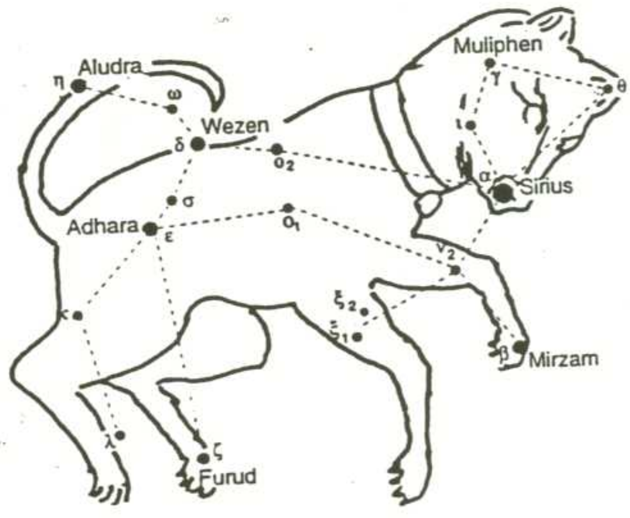
Star's Class: supergiant

Diameter: 37 solar diameters

Luminosity: 50,000 times Sun's brightness

Apparent Magnitude: +2.44

Absolute Magnitude: -7.0



Spectral Type: B5 Ia **Constellation:** CANIS MAJOR *KAY-nis MAY-jer* BIG DOG

Star: **Furud** *FOU-rude*
male apes, also called Phurud

Identification: ζ CMa *Zeta Canis Majoris*

Distance from Earth: 290 light-years

Peak Color: blue

Temperature in Kelvins: 18,000 K

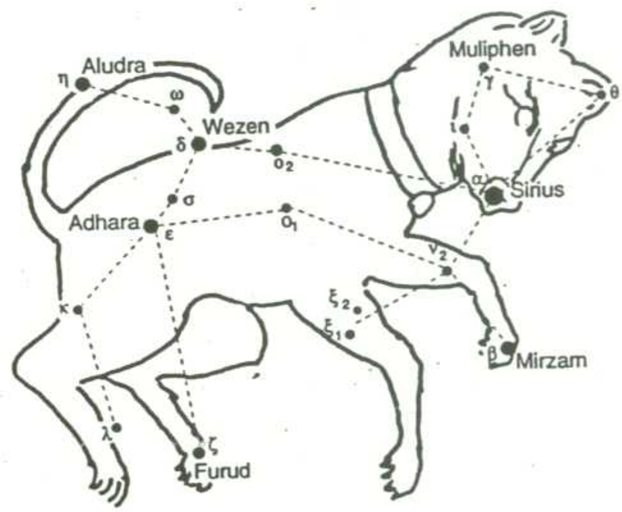
Star's Class: main sequence

Diameter: 2 solar diameters

Luminosity: 377 times Sun's brightness

Apparent Magnitude: +3.02

Absolute Magnitude: -1.7



Spectral Type: B2.5 V Constellation: CANIS MAJOR *KAY-nis MAY-jer* BIG DOG

Star: **Gomeisa** *go-MY-za*
watery eyed (near Milky Way), also called Mirzam

Identification: β CMi *Beta Canis Minoris*

Distance from Earth: 140 light-years

Peak Color: blue

Temperature in Kelvins: 13,000 K

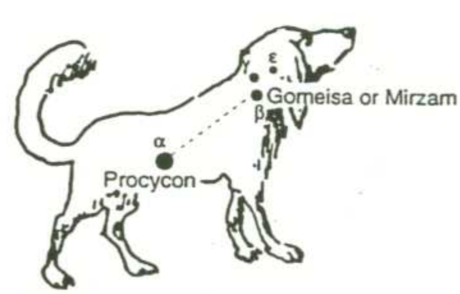
Star's Class: main sequence

Diameter: 2 solar diameters

Luminosity: 95 times Sun's brightness

Apparent Magnitude: +2.90 variable

Absolute Magnitude: -0.2



Spectral Type: B8 Ve Constellation: CANIS MINOR *KAY-niss MY-ner* LITTLE DOG

Star: **Bellatrix** *beh-LAY-trix*
Amazon female warrior

Identification: **γ Ori** *Gamma Orionis*

Distance from Earth: 360 light-years

Peak Color: blue

Temperature in Kelvins: 23,000 K

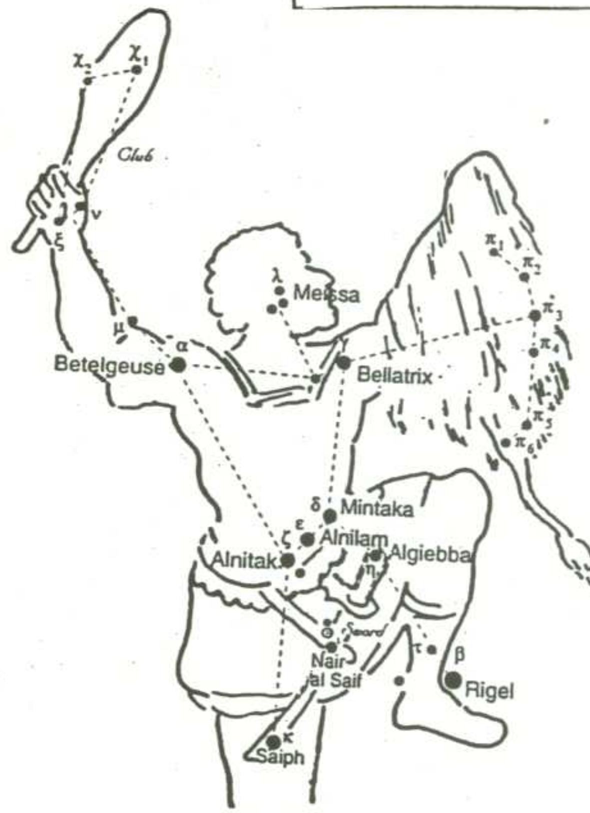
Star's Class: giant

Diameter: 3 solar diameters

Luminosity: 2,168 times Sun's brightness

Apparent Magnitude: +1.64

Absolute Magnitude: -3.6



Spectral Type: B2 III

Constellation: **ORION** *oh-RYE-un* **HUNTER**

Star: **Muliphen** *moo-li-FAYN*
marks the top of the dog's head

Identification: **γ CMa** *Gamma Canis Majoris*

Distance from Earth: 1,000 light-years

Peak Color: blue

Temperature in Kelvins: 14,000 K

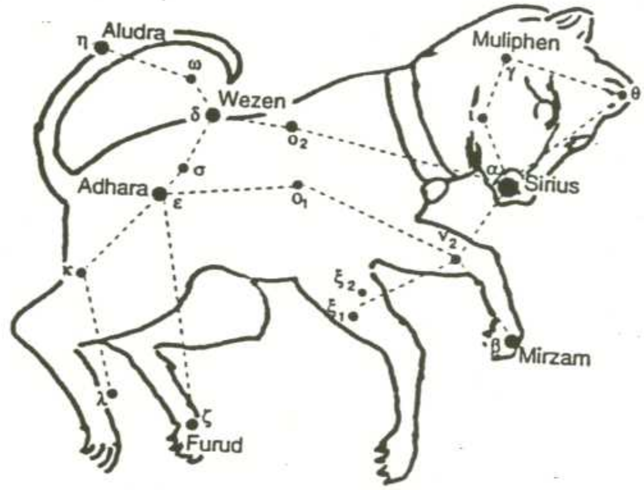
Star's Class: bright giant

Diameter: 5 solar diameters

Luminosity: 1,803 times Sun's brightness

Apparent Magnitude: +4.11

Absolute Magnitude: -3.4



Spectral Type: B8 II

Constellation: **CANIS MAJOR** *KAY-nis MAY-jer* **BIG DOG**

Star: Sirius *SEAR-eh-us*
sparkling; dog star; scorching one; rising before Sun on hottest days of summer

Identification: α CMa *Alpha Canis Majoris*

Distance from Earth: 9 light-years

Peak Color: blue-white

Temperature in Kelvins: 9,700 K

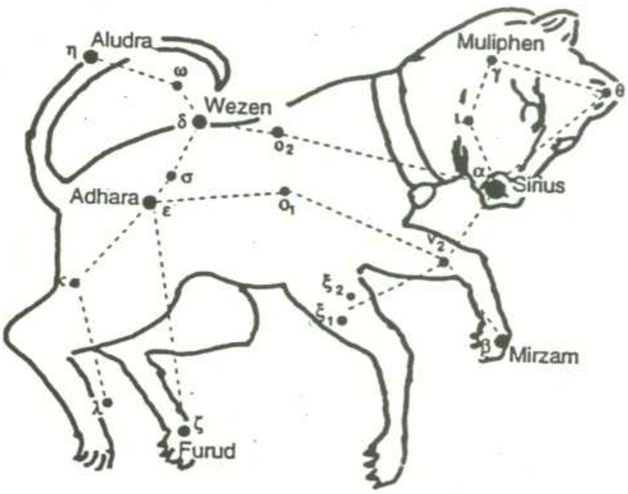
Star's Class: main sequence

Diameter: 2 solar diameters

Luminosity: 21 times Sun's brightness

Apparent Magnitude: -1.46

Absolute Magnitude: +1.42



Spectral Type: A1 V **Constellation:** CANIS MAJOR *KAY-nis MAY-jer* BIG DOG

Star: Castor *CASS-ter*
horseman, mortal twin

Identification: α Gem *Alpha Geminorum*

Distance from Earth: 47 light-years

Peak Color: blue-white

Temperature in Kelvins: 9,300 K

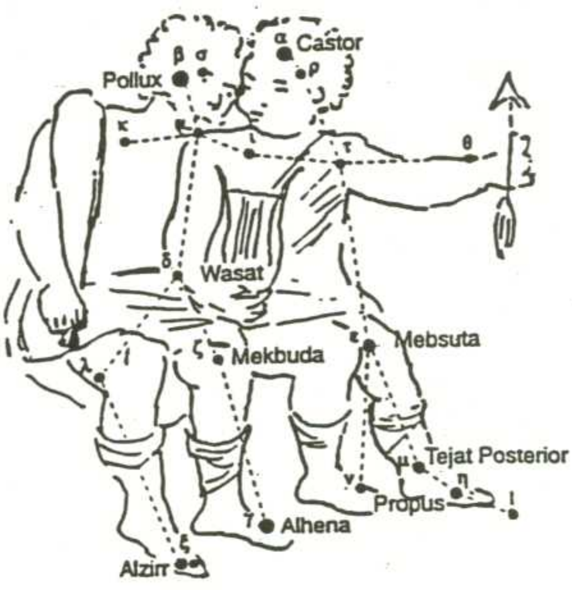
Star's Class: main sequence

Diameter: 2 solar diameters

Luminosity: 28 times Sun's brightness

Apparent Magnitude: +1.58

Absolute Magnitude: +1.14



Spectral Type: A1 V **Constellation:** GEMINI *GEM-in-eye* TWINS

Star: Alhena *al-HEN-ah*
brand mark

Identification: γ Gem *Gamma Geminorum*

Distance from Earth: 88 light-years

Peak Color: blue-white

Temperature in Kelvins: 9,800 K

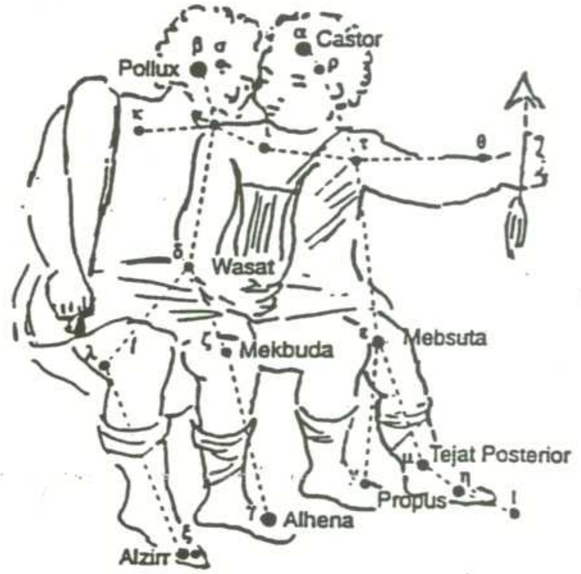
Star's Class: subgiant

Diameter: 3 solar diameters

Luminosity: 79 times Sun's brightness

Apparent Magnitude: +1.93

Absolute Magnitude: 0



Spectral Type: A0 IV **Constellation:** GEMINI *GEM-in-eye* TWINS

Star: Theta Auriga *THAY-tah Auriga*
marks wrist of charioteer

Identification: θ Aur *Theta Aurigae*

Distance from Earth: 150 light-years

Peak Color: blue-white

Temperature in Kelvins: 10,000 K

Star's Class: peculiar

Diameter: 2 solar diameters

Luminosity: 146 times Sun's brightness

Apparent Magnitude: +2.62 variable

Absolute Magnitude: -0.7

Spectral Type: A0 pec **Constellation:** AURIGA *au-RYE-gah* CHARIOTEER

Star: Capella *kah-PELL-ah*

little she-goat, goat star, rainy goat star

Identification: α Aur *Alpha Aurigae*

Distance from Earth: 44 light-years

Peak Color: yellow

Temperature in Kelvins: 5,100 K

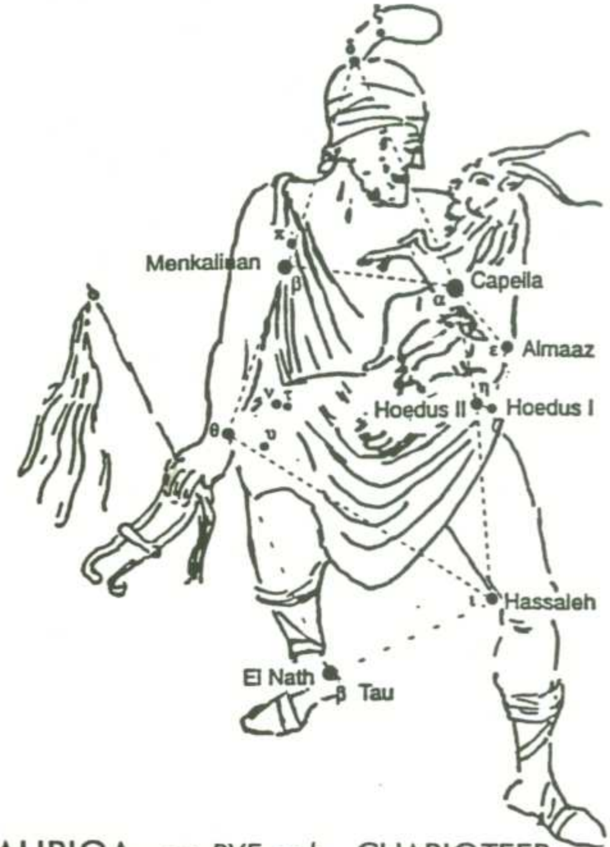
Star's Class: giant

Diameter: 11 solar diameters

Luminosity: 72 times Sun's brightness

Apparent Magnitude: +0.08

Absolute Magnitude: +0.09



Spectral Type: G8 III

Constellation: AURIGA *au-RYE-gah* CHARIOTEER

Star: Sun

Distance from Earth: 8.3 light-minutes

Peak Color: yellow

Temperature in Kelvins: 5,800 K

Star's Class: main sequence

Diameter: 1 solar diameter

Luminosity: 1 times Sun's brightness

Apparent Magnitude: -26.72

Absolute Magnitude: +4.74

Spectral Type: G2 V

Star: Nihal *HIGH-al*
camels quenching their thirst

Identification: β Lep *Beta Leporis*

Distance from Earth: 320 light-years

Peak Color: yellow

Temperature in Kelvins: 5,600 K

Star's Class: bright giant

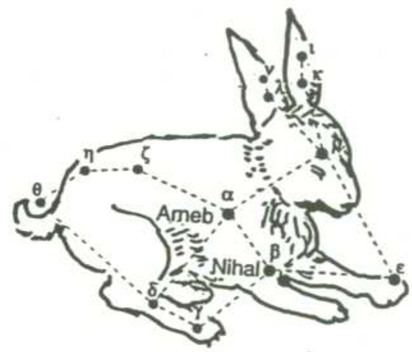
Diameter: 30 solar diameters

Luminosity: 545 times Sun's brightness

Apparent Magnitude: +2.84

Absolute Magnitude: -2.1

Spectral Type: G5 II **Constellation:** LEPUS *LEE-puss* HARE



Star: Mebsuta *meb-SUE-tah*
outstretched paw of the lion

Identification: ε Gem *Epsilon Geminorum*

Distance from Earth: 190 light-years

Peak Color: yellow

Temperature in Kelvins: 5,000 K

Star's Class: supergiant

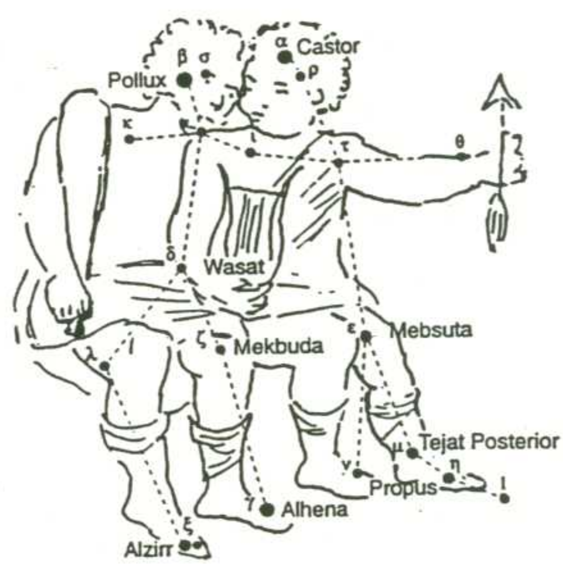
Diameter: 33 solar diameters

Luminosity: 175 times Sun's brightness

Apparent Magnitude: +2.98

Absolute Magnitude: -0.9

Spectral Type: G8 Ib **Constellation:** GEMINI *GEM-in-eye* TWINS



Star: Ain *EYE-n*
eye

Identification: ε Tau *Epsilon Tauri*

Distance from Earth: 150 light-years

Peak Color: yellow

Temperature in Kelvins: 5,000 K

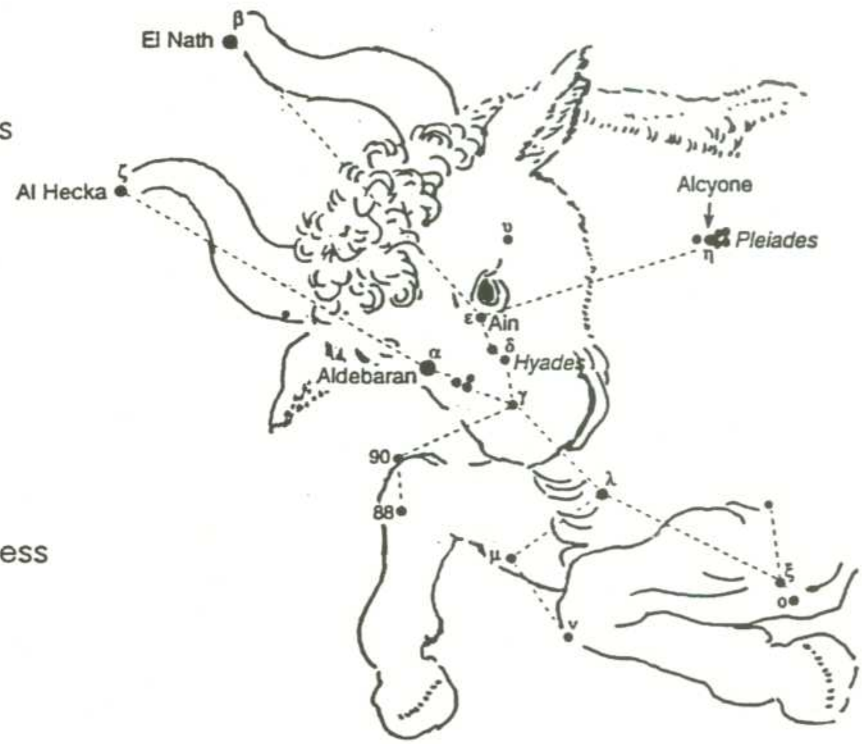
Star's Class: giant

Diameter: 13 solar diameters

Luminosity: 65 times Sun's brightness

Apparent Magnitude: +3.53

Absolute Magnitude: +0.2



Spectral Type: G9.5III **Constellation:** TAURUS *TAW-russ* BULL

Star: Mekbuda *mek-BOO-dah*
folded paw of the lion

Identification: ζ Gem *Zeta Geminorum*

Distance from Earth: 1,500 light-years

Peak Color: yellow

Temperature in Kelvins: 5,700 K

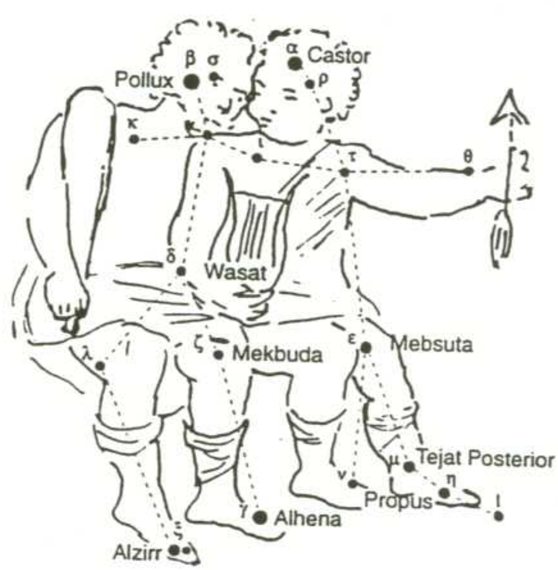
Star's Class: supergiant

Diameter: 86 solar diameters

Luminosity: 5,000 times Sun's brightness

Apparent Magnitude: +3.79 variable

Absolute Magnitude: -4.5



Spectral Type: G0 Ib **Constellation:** GEMINI *GEM-in-eye* TWINS

Star: Aldebaran *al-DEB-ah-ran*
follower (of the Pleiades)

Identification: α Tau *Alpha Tauri*

Distance from Earth: 65 light-years

Peak Color: orange

Temperature in Kelvins: 4,000 K

Star's Class: giant

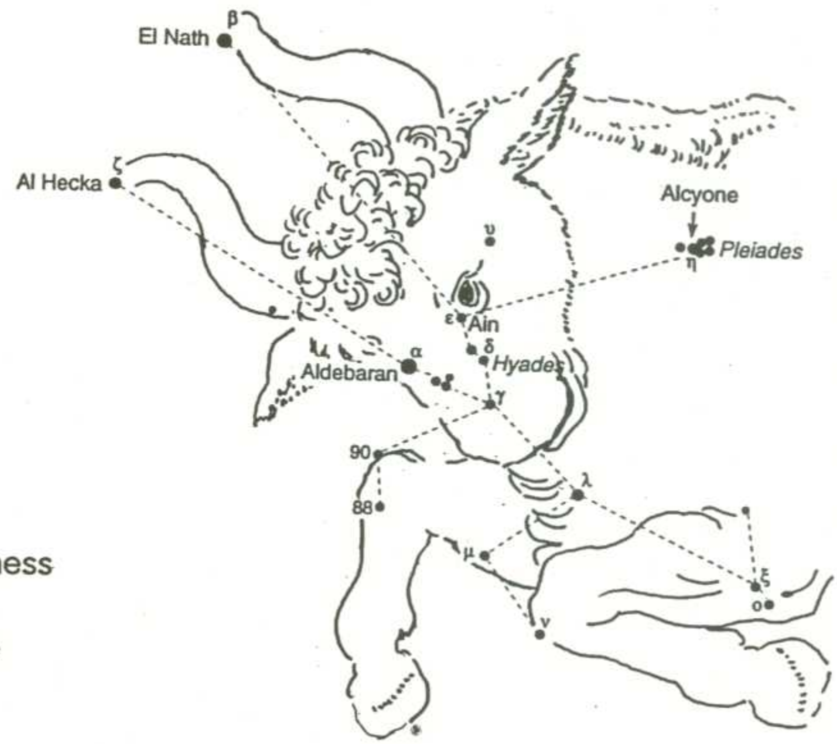
Diameter: 34 solar diameters

Luminosity: 137 times Sun's brightness

Apparent Magnitude: +0.85 variable

Absolute Magnitude: -0.6

Spectral Type: K5 III



Constellation: **TAURUS** *TAW-russ* **BULL**

Star: Pollux *PAUL-lucks*
boxer, immortal twin

Identification: β Gem *Beta Geminorum*

Distance from Earth: 35 light-years

Peak Color: orange

Temperature in Kelvins: 4,900 K

Star's Class: giant

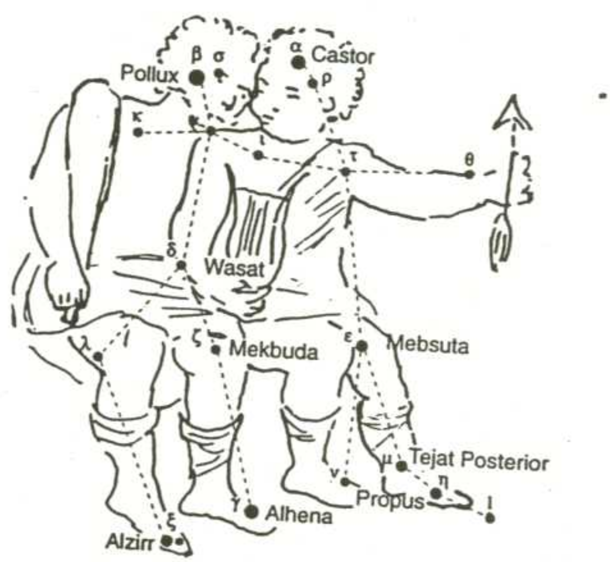
Diameter: 9 solar diameters

Luminosity: 32 times Sun's brightness

Apparent Magnitude: +1.14

Absolute Magnitude: +0.98

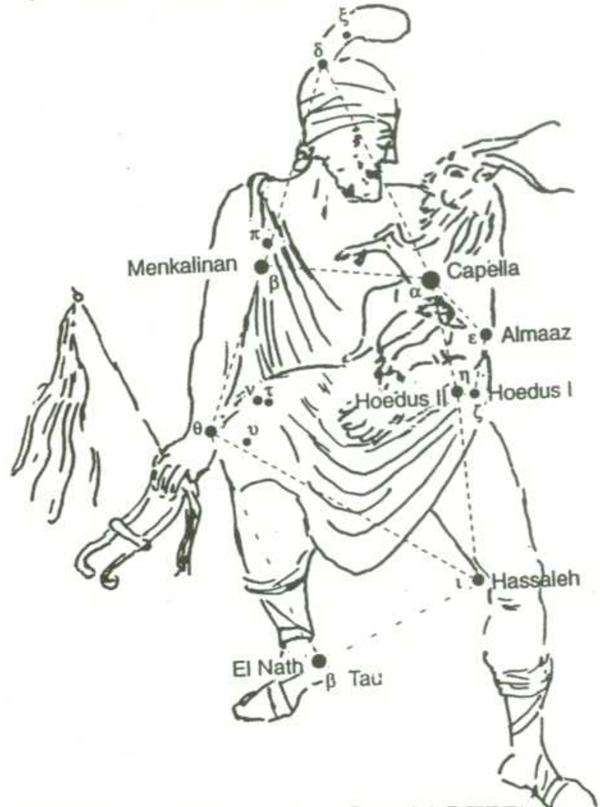
Spectral Type: K0 IIIb



Constellation: **GEMINI** *GEM-in-eye* **TWINS**

Star: Hoedus I *HEE-dus 1*

one of kid goats; rising before Sun marks stormy season; also called Sadatoni



Identification: ζ Aur *Zeta Aurigae*

Distance from Earth: 530 light-years

Peak Color: orange

Temperature in Kelvins: 4,300 K

Star's Class: bright giant

Diameter: 53 solar diameters

Luminosity: 655 times Sun's brightness

Apparent Magnitude: +3.75 variable

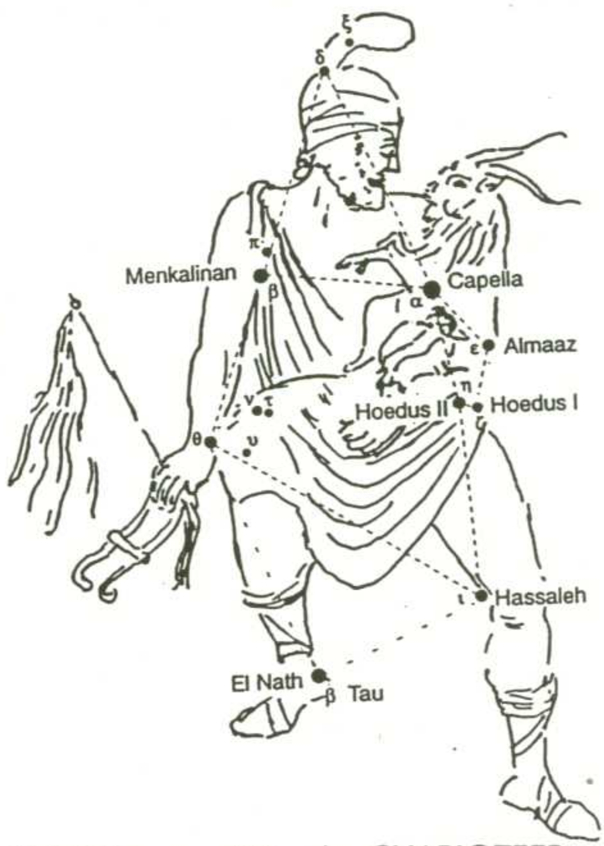
Absolute Magnitude: -2.3

Spectral Type: K4 II

Constellation: AURIGA *au-RYE-gah* CHARIOTEER

Star: Hassaleh *hah-SAW-leh*

marks back of charioteer's knee



Identification: ι Aur *Iota Aurigae*

Distance from Earth: 330 light-years

Peak Color: orange

Temperature in Kelvins: 4,200 K

Star's Class: bright giant

Diameter: 73 solar diameters

Luminosity: 655 times Sun's brightness

Apparent Magnitude: +2.69

Absolute Magnitude: -2.3

Spectral Type: K3 II

Constellation: AURIGA *au-RYE-gah* CHARIOTEER

Star: **Propus** *PRO-puss*
the projecting foot; also called Tejat Prior

Identification: η Gem *Eta Geminorum*

Distance from Earth: 190 light-years

Peak Color: red

Temperature in Kelvins: 3,100 K

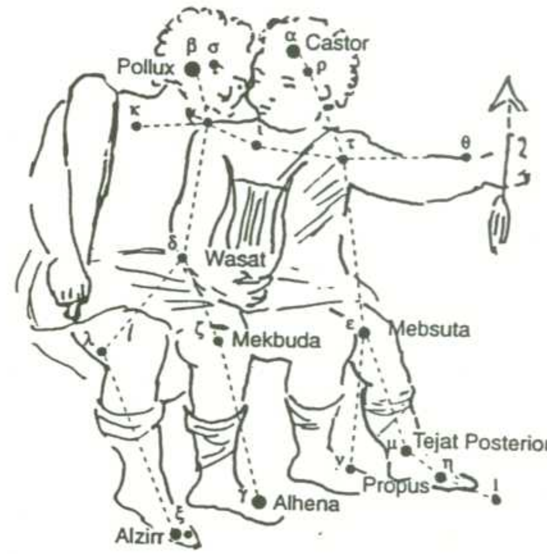
Star's Class: giant

Diameter: 34 solar diameters

Luminosity: 125 times Sun's brightness

Apparent Magnitude: +3.28 variable

Absolute Magnitude: -0.5



Spectral Type: M3 III Constellation: **GEMINI** *GEM-in-eye* TWINS

Star: **Tejat Posterior** *TAY-got posterior*
heel

Identification: μ Gem *Mu Geminorum*

Distance from Earth: 160 light-years

Peak Color: red

Temperature in Kelvins: 2,900 K

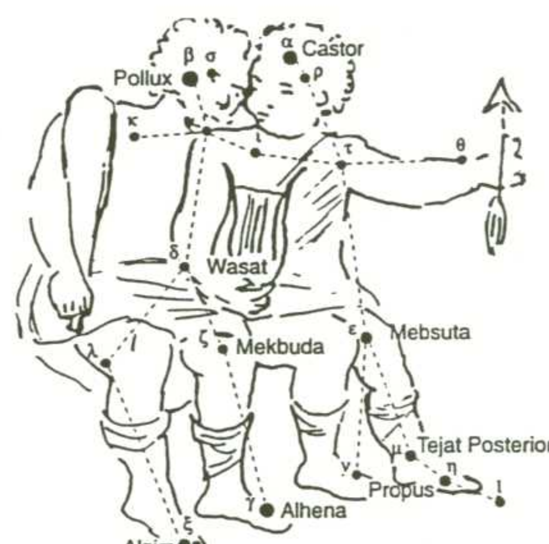
Star's Class: giant

Diameter: 35 solar diameters

Luminosity: 125 times Sun's brightness

Apparent Magnitude: +2.88 variable

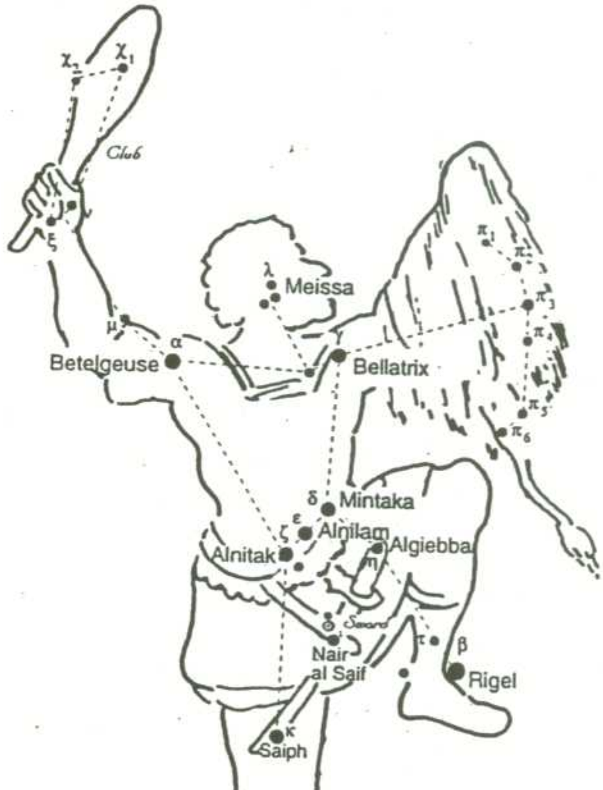
Absolute Magnitude: -0.5



Spectral Type: M3 IIIa Constellation: **GEMINI** *GEM-in-eye* TWINS

Star: Betelgeuse *BET-el-jooz*

arm of central one; armpit of white belted sheep



Identification: α Ori *Alpha Orionis*

Distance from Earth: 325 light-years

Peak Color: red

Temperature in Kelvins: 3,400 K

Star's Class: supergiant

Diameter: 265 solar diameters

Luminosity: 5,000 times Sun's brightness

Apparent Magnitude: +0.50 variable

Absolute Magnitude: -4.5

Spectral Type: M1 Iab

Constellation: ORION *oh-RYE-un* HUNTER

Star: Menkalinan *men-CALL-ih-nan*

shoulder of the rein holder

Identification: β Aur *Beta Aurigae*

Distance from Earth: 80 light-years

Peak Color: blue-white

Temperature in Kelvins: 9,000 K

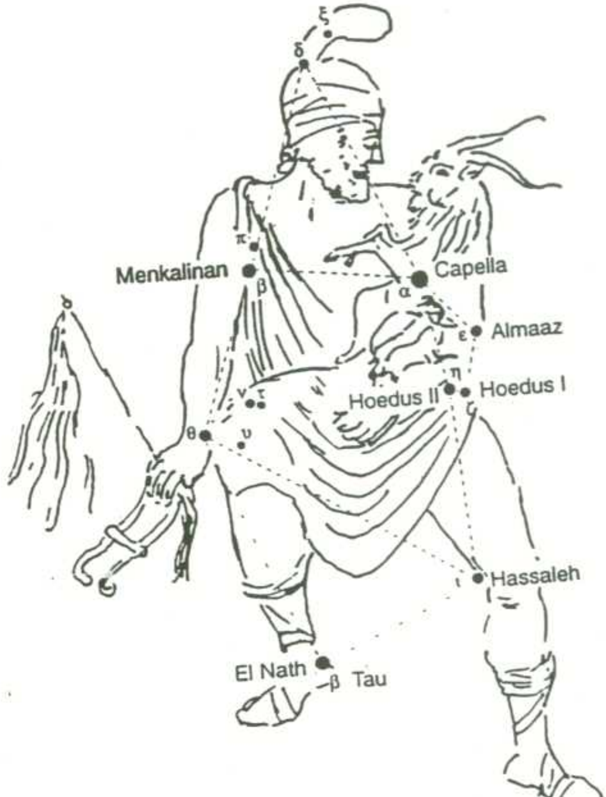
Star's Class: subgiant

Diameter: 2 solar diameters

Luminosity: 45 times Sun's brightness

Apparent Magnitude: +1.90 variable

Absolute Magnitude: +0.6



Spectral Type: A2 IV

Constellation: AURIGA *au-RYE-gah* CHARIOTEER

Star: El Nath *EL-nath*

the one butting with horns

Identification: β Tau *Beta Tauri*

Distance from Earth: 150 light-years

Peak Color: blue

Temperature in Kelvins: 14,000 K

Star's Class: giant

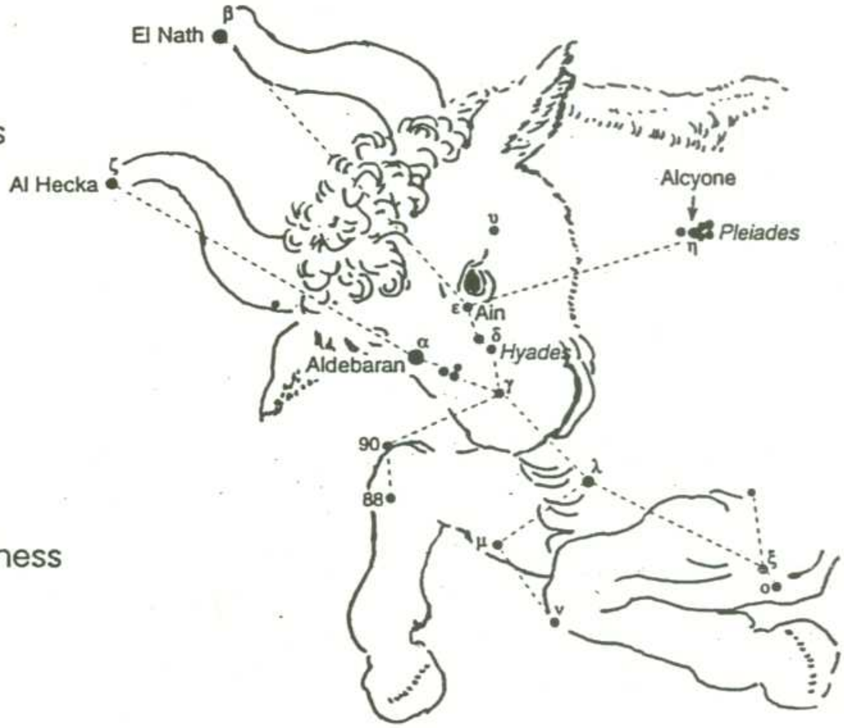
Diameter: 2 solar diameters

Luminosity: 344 times Sun's brightness

Apparent Magnitude: +1.65

Absolute Magnitude: -1.6

Spectral Type: B7 III



Constellation: TAURUS *TAW-russ* BULL