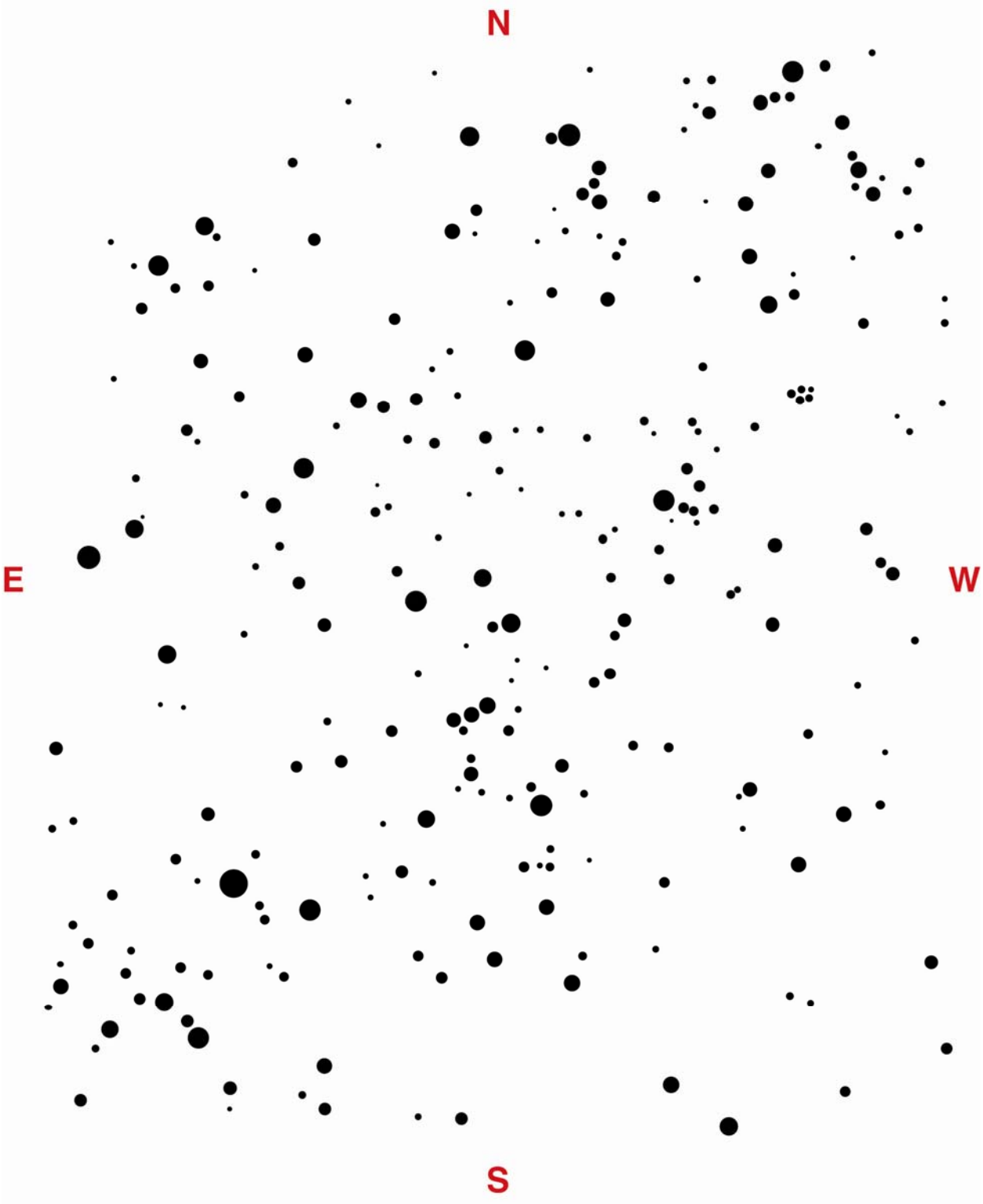
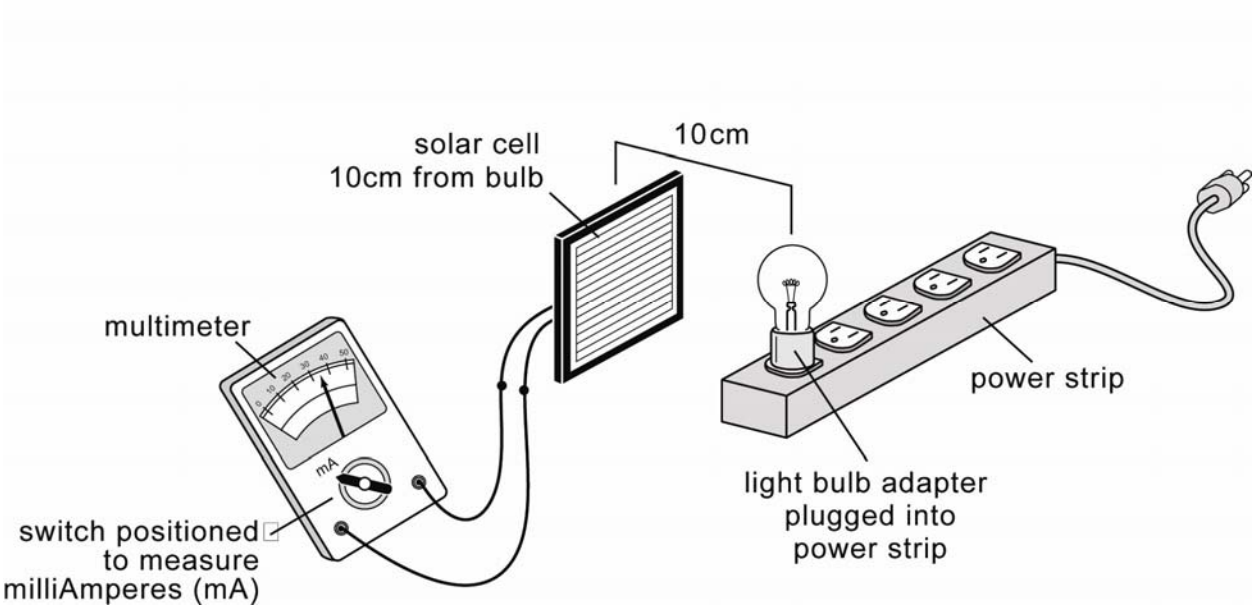
Copymaster Number	Copymaster Name
Copymaster 1	Star Pictures
Copymaster 2	Explore: Station 1 Set-up
Copymaster 3	Explore: Station 2 Set-up
Copymaster 4	Explore: Station 3 Set-up
Copymaster 5	Explore: Station 4 Set-up
Copymaster 6	Star Data
Copymaster 7a	Distance versus Temperature Graph
Copymaster 7b	Distance versus Temperature Graph—Answer Key
Copymaster 8a	Luminosity versus Temperature Graph
Copymaster 8b	Luminosity versus Temperature Graph—Answer Key
Copymaster 9a	Features Matrix for Nuclear Reactions in Stars
Copymaster 9b	Features Matrix for Nuclear Reactions in Stars—Answer Key
Copymaster 10a	The Sun's Scrapbook
Copymaster 10b	The Sun's Scrapbook—Answer Key
Copymaster 11	A Season of Stars
Copymaster 12	Resources for *Astronomy Club*
Copymaster 13	H-R Diagram
Copymaster 14	Scoring Rubric—Astronomy Club

Star Pictures



Explore: *Star Light, Star Bright*
Station 1 Set-up



a.

Bulb Number	Bulb Wattage (Watts)	Multimeter Current (mA)
#1		
#2		
#3		

b.

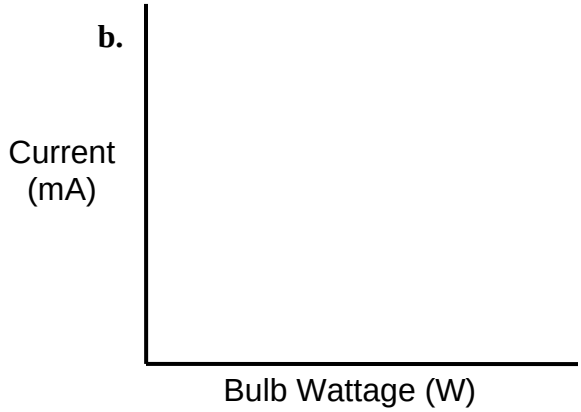
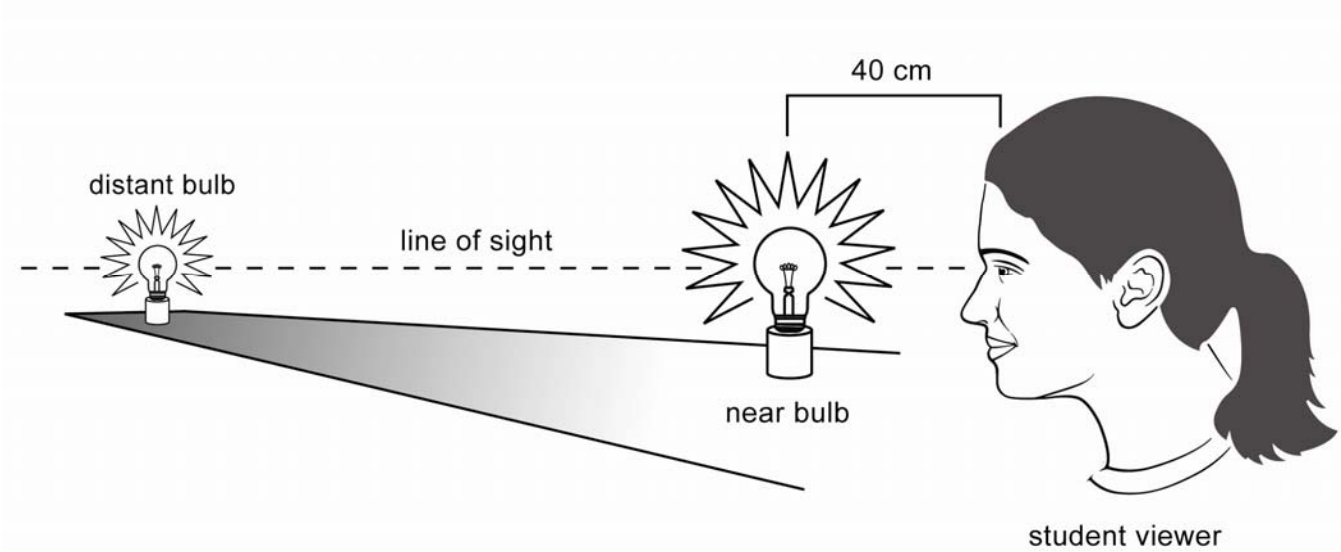


Figure 4: Current and Watts. Use (a) the table and (b) simple graph like this for your work. They help you show how the power of a bulb relates to its wattage.

Explore: *Star Light, Star Bright*
Station 2 Set-up



Explore: *Star Light, Star Bright*
Station 3 Set-up

Copy the graphs below into your science notebook and complete the two graphs.

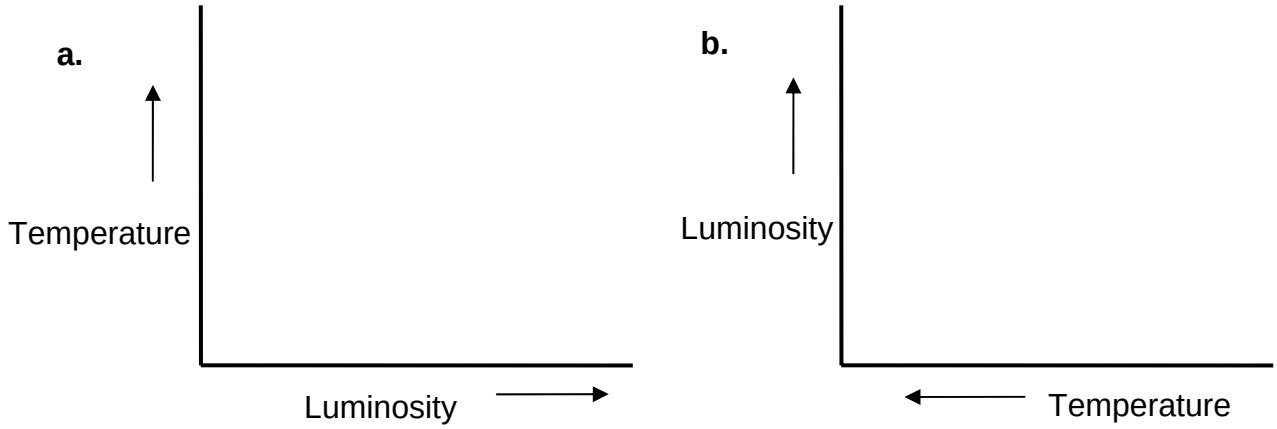


Figure 5: Temperature and Brightness. Use a line to show how temperature changes with luminosity (a). You can show the same relationship another way in (b).

Copy the graphs below into your science notebook and complete the two graphs.

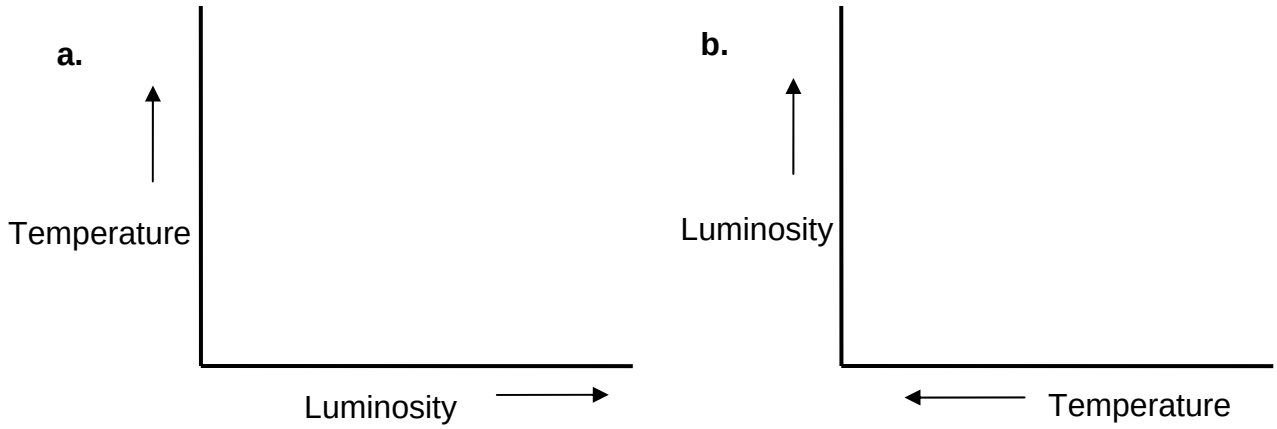
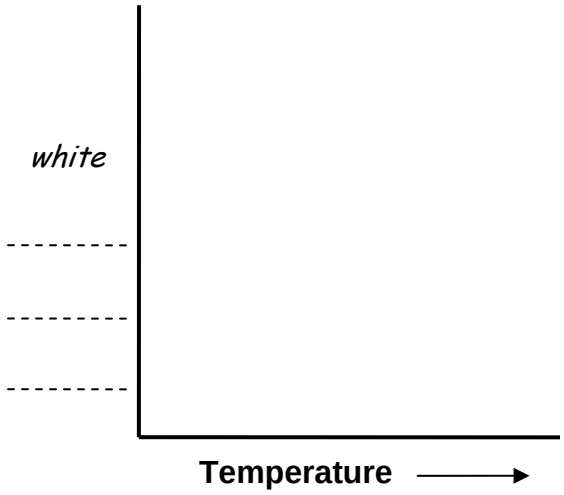


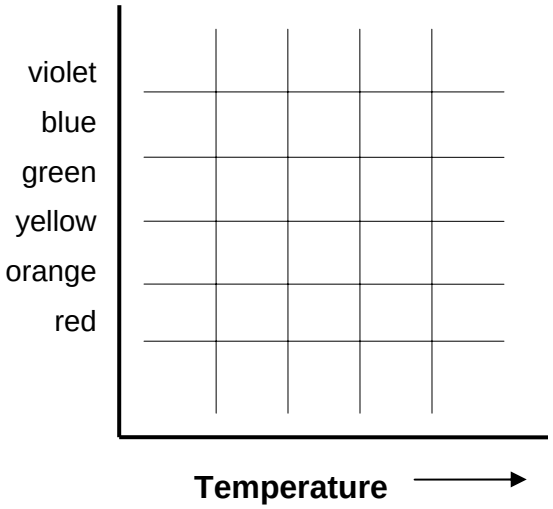
Figure 5: Temperature and Brightness. Use a line to show how temperature changes with luminosity (a). You can show the same relationship another way in (b).

Explore: *Star Light, Star Bright*
Station 4 Set-up

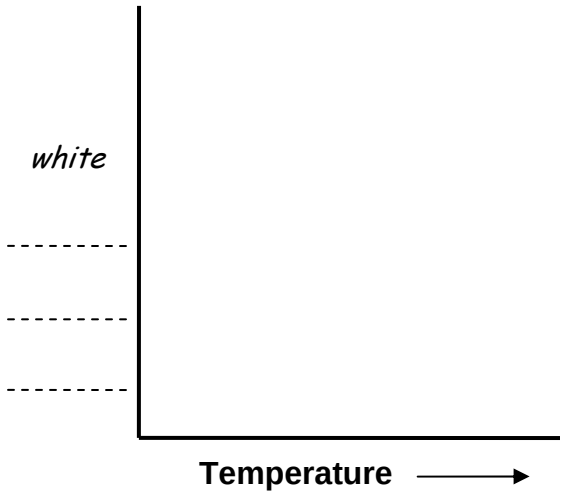
a. See with eyes



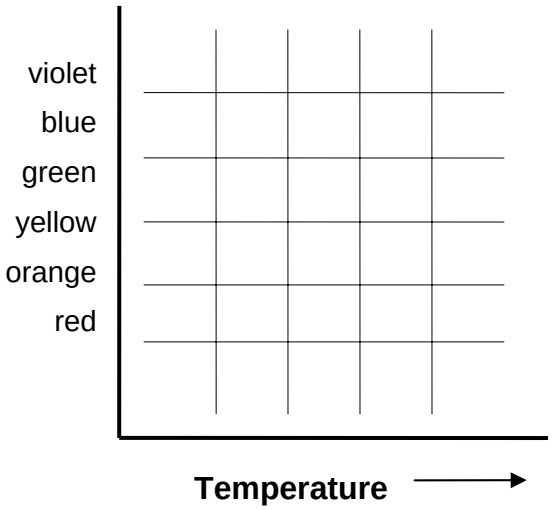
b. See with glasses



a. See with eyes



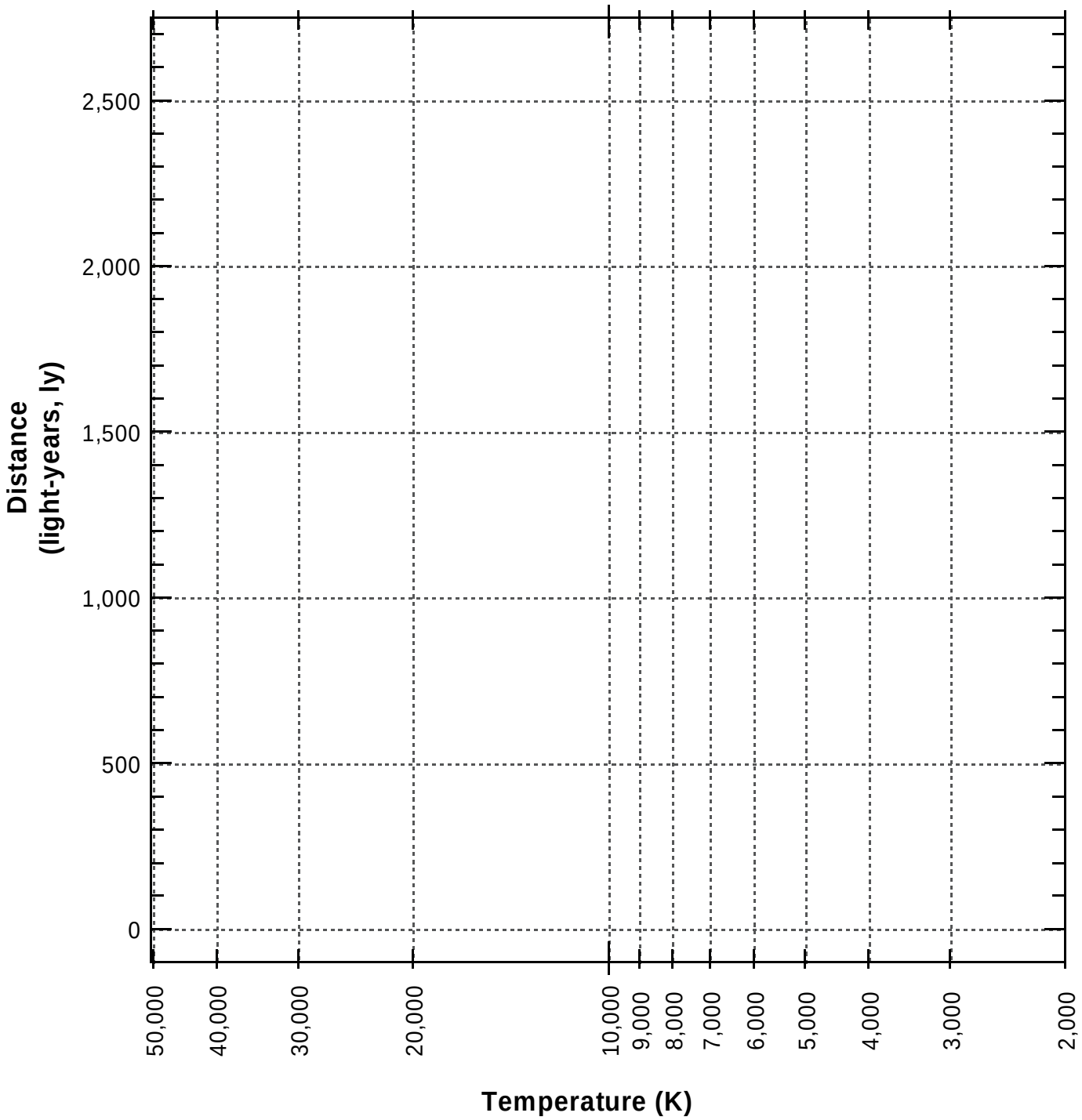
b. See with glasses



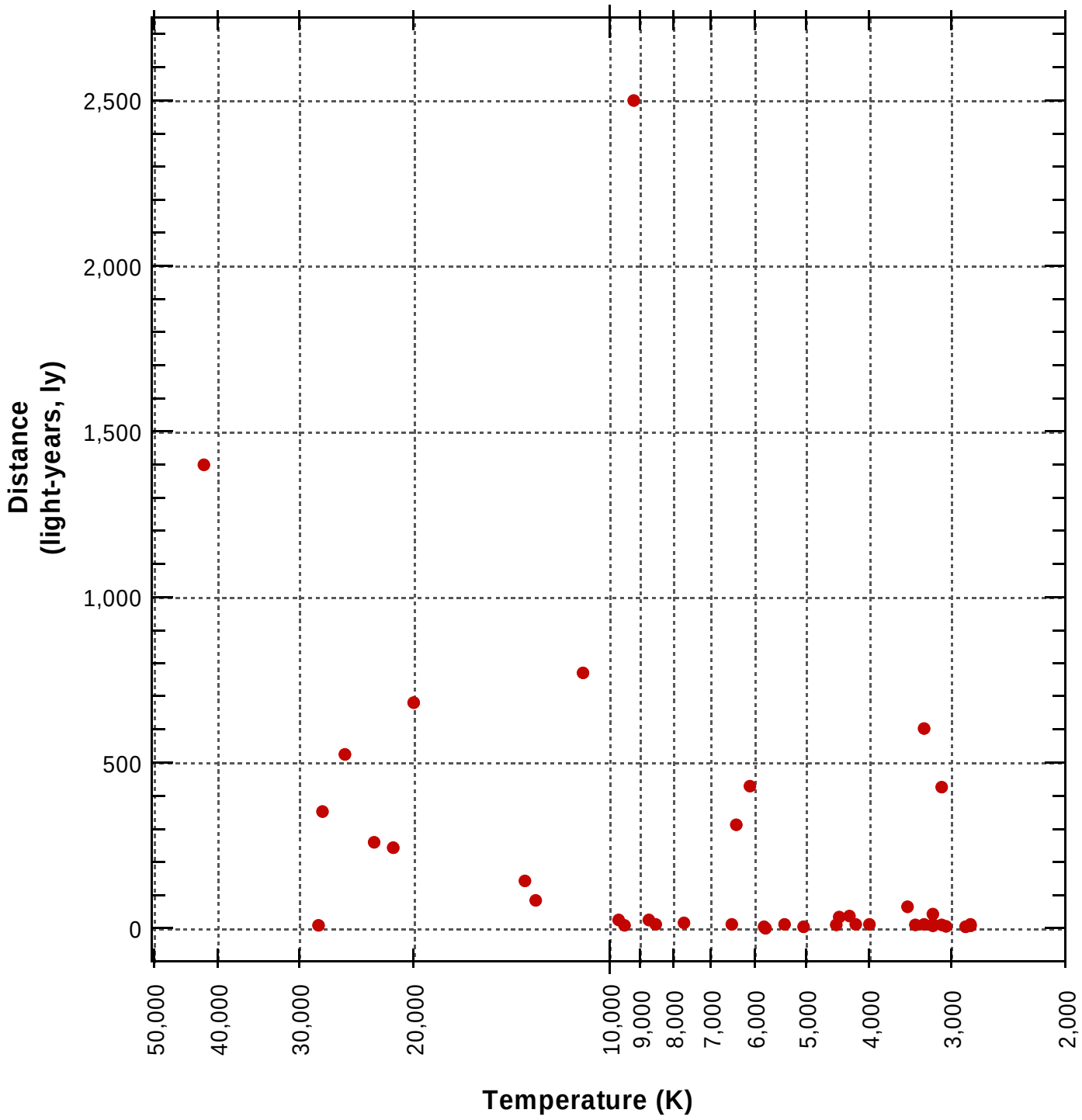
Star Data

Star name	Surface temperature (Kelvin)	Distance to Earth (ly)	Luminosity (solar units) (L_{star}/L_{Sun})
Proxima Centauri	2,850	4.2	0.0006
Sirius A	9,500	8.7	26
Sirius B	28,000	8.7	0.01
Betelgeuse	3,100	427	60,000
Zeta Puppis	42,000	1,400	750,000
Vega	9,700	25	60
Rigel A	11,000	772	70,000
Procyon B	8,500	11.4	0.0005
Achernar	13,500	144	1,000
Altair	7,700	17	10.5
Aldebaran B	3,500	65	350
Beta Crucis	27,600	352	37,000
Spica	23,000	260	23,000
Fomalhaut A	8,720	25	18
Regulus	13,000	85	150
Adhara	20,000	681	15,000
Sun	5,770	0	1
Ross 154	3,100	9.7	0.004
Deneb	9,200	2,500	300,000
61 Cygnus A	4,200	11.4	0.15
61 Cygnus B	4,000	11.4	0.09
Epsilon Eridani	4,500	10.5	0.37
Gliese 725 B	3,200	11.4	0.01
DX Cancri	2,800	11.8	0.0003
Lacaille 9352	3,400	10.73	0.05
Beta Centauri	25,500	525	86,000
Arcturus	4,290	37	175
Antares	3,300	604	30,000
Polaris	6,100	430	3,000
τ ceti	5,400	11.9	0.59
Merak	9,000	79	60

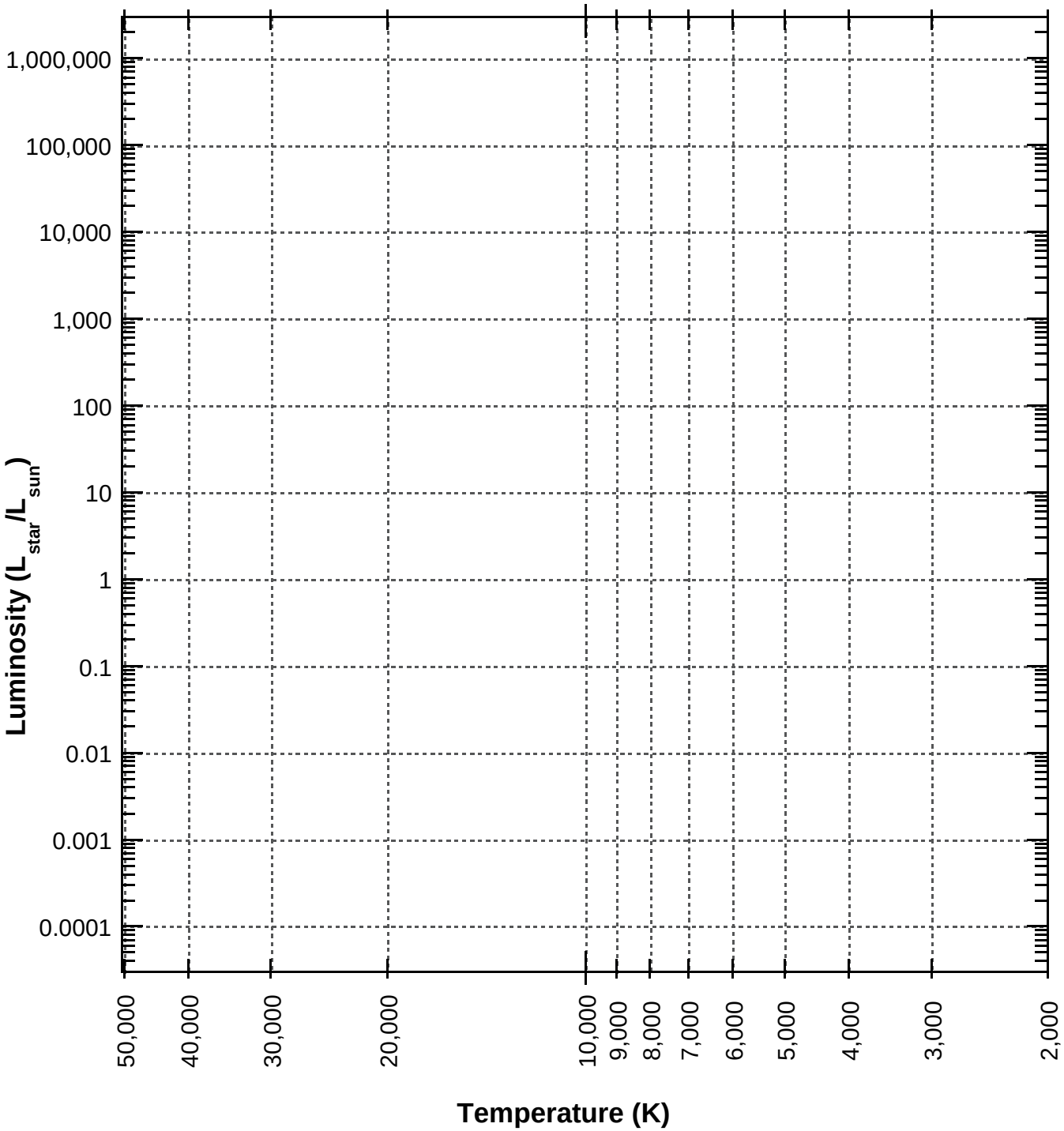
Distance versus Temperature Graph



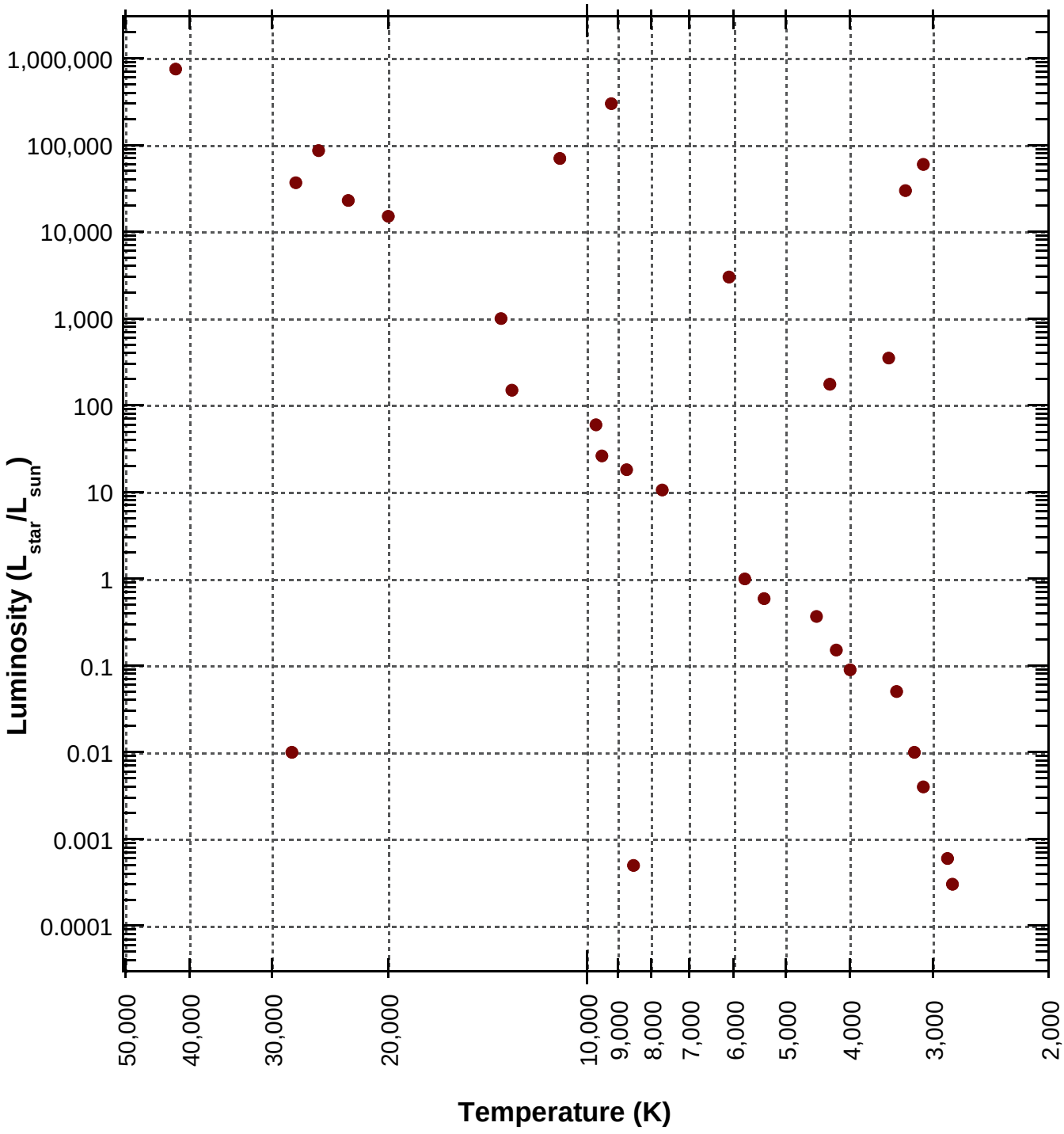
Distance versus Temperature Graph—Answer Key



Luminosity versus Temperature Graph



Luminosity versus Temperature Graph—Answer Key



Features Matrix for Nuclear Reactions in Stars

Complete this matrix for the reactions with hydrogen in figures 12 and 13.

Feature		Reactants	Products
Chemical Reaction	Number of hydrogen		
	Number of oxygen		
	Lots of energy? (Yes or No)		
Fusion Reaction	Number of hydrogen		
	Number of helium		
	Lots of energy? (Yes or No)		

For the feature listed, write a word or phrase for the chemical and fusion reactions in figures 12 and 13.

Feature of the reaction	Chemical Reaction	Fusion Reaction
Does the reaction have atoms or molecules?		
Are new elements produced?		
Lots of energy produced?		
Where does reaction occur?		
Temperatures for reaction?		

Features Matrix for Nuclear Reactions in Stars—Answer Key

Complete this matrix for the reactions with hydrogen in figures 12 and 13.

Feature		Reactants	Products
Chemical Reaction	Number of hydrogen	**4**	**4**
	Number of oxygen	**2**	**2**
	Lots of energy? (Yes or No)	**No**	**No**
Fusion Reaction	Number of hydrogen	**4**	**0**
	Number of helium	**0**	**1**
	Lots of energy? (Yes or No)	**No**	**Yes**

For the feature listed, write a word or phrase for the chemical and fusion reactions in figure 12 and 13.

Feature of the reaction	Chemical Reaction	Fusion Reaction
Does the reaction have atoms or molecules?	**molecules**	**atoms**
Are new elements produced?	**No**	**Yes - Helium**
Lots of energy produced?	**No**	**Yes**
Where does reaction occur?	**Surface of Earth**	**Cores of stars**
Temperatures for reaction?	**regular**	**Millions of degrees**

The Sun's Scrapbook

Stage	Key feature, or H-R star field	Estimated duration (years)	Surface temperature (est. in K)	Luminosity (vs. L_{Sun})	Radius (vs. R_{Sun})
1-Position	Gaseous protostar	—			
2-Transition	Collapsing protostar	50 million			
3-Position		~ 10 billion			
4-Transition	Expanding shells around red giant	~ 1 billion			
5-Position		0.1 billion (100 million)			
6-Transition	Contraction or expansion	< 0.1 billion			
7-Position		Fast (~ 1 million)			
8-Transition	Exploding out shell—nebula	< 1 million			
9-Position		—			
10-Transition	Cooling carbon core	—			
11-Position		—			

The Sun's Scrapbook—Answer Key

Stage	Key feature, or H-R star field	Estimated duration (years)	Surface temperature (est. in K)	Luminosity (vs. L_{Sun})	Radius (vs. R_{Sun})
1-Position	Gaseous protostar	—	**~2,000**	**$100=10^2$**	**100**
2-Transition	Collapsing protostar	50 million	**3,000**	**10**	**10**
3-Position	**Main Sequence**	~ 10 billion	**6,000**	**1**	**1**
4-Transition	Expanding shells around red giant	~ 1 billion	**4,000**	**30**	**10**
5-Position	**Giant**	0.1 billion (100 million)	**3,300**	**1,000**	**10^2 = 100**
6-Transition	Contraction or expansion	< 0.1 billion	**5,000**	**~ 500**	**3×10 = 30**
7-Position	**Super Giant**	Fast (~ 1 million)	**~ 3,600**	**~ 30,000**	**5×10^2 = 500**
8-Transition	Exploding out shell—nebula	< 1 million	**10,000**	**~ 30,000**	**50**
9-Position	**White Dwarf**	—	**20,000**	**$0.01 = 10^{-2}$**	**10^{-2}**
10-Transition	Cooling carbon core	—	**6,000**	**$0.0001 = 10^{-4}$**	**10^{-2}**
11-Position	**Black Dwarf**	—	**1,000**	**$0.000001 = 10^{-6}$**	**10^{-2}**

A Season of Stars

Stars of the North Polar Region

Alcor	Caph	Megrez	Polaris
Alderamin	Dubhe	Merak	Schedar
Alioth	Eltanin	Mizar	Thuban
Alkaid	Kochab	Phecda	

Stars of the Northern Hemisphere Visible in the Fall (Southern Hemisphere in the Spring)

Algenib	Ankaa	Markab	Sadalmelik
Algol	Diphda	Menkar	Scheat
Almach	Enif	Mira	
Al Nair	Fomalhaut	Mirach	
Alpheratz	Hamal	Mirfak	

Stars of the Northern Hemisphere Visible in the Winter (Southern Hemisphere in the Summer)

Acamar	Aludra	Elnath	Pollux
Achernar	Arneb	Menkalinan	Procyon
Adhara	Avior	Miaplacidus	Rigel
Alcyone	Bellatrix	Mintaka	Saiph
Aldebaran	Betelgeuse	Mirzam	Sirius
Alhena	Canopus	Naos, or Suhail	Suhail
Alnilam	Capella	Hadar	Wezen
Alnitak	Castor	Nihal	

Stars of the Northern Hemisphere Visible in the Spring (Southern Hemisphere in the Fall)

Algeiba	Denebola	Menkent	Spica
Alphard	Gienah	Regulus	Vindemiatrix
Arcturus	Hadar	Rigel Kentaurus	
Cor Caroli	Izar	Rigel Kentaurus B	

Stars of the Northern Hemisphere Visible in the Summer (Southern Hemisphere in the Winter)

Albireo	Deneb	Rasalgethi	Shaula
Alphecca	Dschubba	Rasalhague	Tarazed
Alshain	Gienah cygni	Sabik	Unukalhai
Altair	Kaus Australis	Sadr	Vega
Antares	Nunki	Sargas	Zubenelgenubi

Stars of the South Polar Region

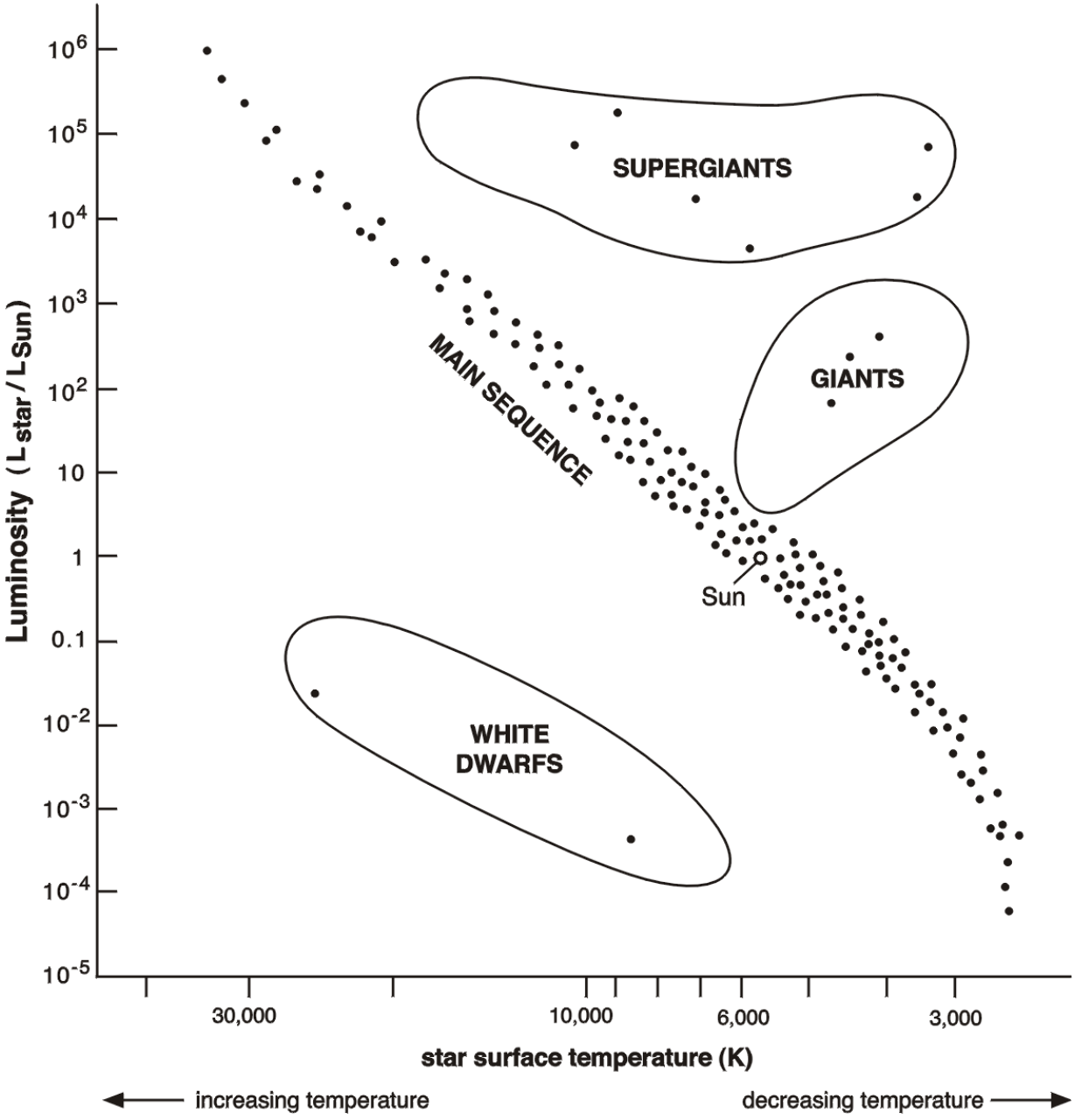
Acrux	Mimosa
Atria	Peacock
Gacrux	

Resources for *Astronomy Club*

Data on individual stars is very common, and much is now available on the Web. Some useful Web sites include the following:

- Peoria Astronomical Society (http://www.astronomical.org/portal/modules/wfsection/index.php?category=1)
- University of Oklahoma, History of the Constellations (http://hsci.cas.ou.edu/exhibits/exhibit.php?exbgrp=3&exbid=20&exbpg=0)
- Chris Dolan (graduate student at the University of Wisconsin) (http://www.astro.wisc.edu/~dolan/constellations/constellation_list.html)
- Dome of the Sky™ (http://domeofthesky.com/clicks/alphalist.html)
- Gordon Speer's Table of Main Sequence Stars (http://www.essex1.com/people/speer/main.html)

H-R Diagram


SUPERGIANTS
GIANTS
MAIN SEQUENCE
Sun
WHITE DWARFS
Luminosity (L star / L Sun)
10^6
10^5
10^4
10^3
10^2
10
1
0.1
10^-2
10^-3
10^-4
10^-5
30,000
10,000
6,000
3,000
star surface temperature (K)
increasing temperature
decreasing temperature

Scoring Rubric—Astronomy Club

Higher levels of performance

Weight	Task	3	2	1
35%	**1. works well with partner or team in activity**	Student works well with partner or team to gather star data, and construct a certificate of appreciation.	Student can improve on working constructively with partner or team, and can contribute more to making the certificate.	Student does not work well with partner. Student could do more to contribute to making the certificate.
30%	**2. completes research, data sheet, and reference list**	Students use a *variety* of references to collect data on their star, and each is cited in reference list as required by teacher. Data sheet is clearly organized and accurate.	Students use only a few references for data on their star, and each is cited in reference list. Directions for reference list are followed. Data sheet is clearly organized and accurate.	Students use only 1-2 references for star data, and each is cited in reference list. Directions for reference list are not followed. Data sheet is not clearly organized and may include errors.
35%	**3. develops attractive, creative certificate of appreciation**	Team develops an accurate, creative, professional looking certificate of appreciation to present to stellar donor. Includes star plotted on colored H-R diagram.	Team develops a nice looking certificate of appreciation, but it doesn't exhibit a lot of creativity. Star is plotted on H-R diagram, but position might not be accurate, or colors missing.	Certificate appears that not much work or creativity went into it. Star is plotted on H-R diagram, but in wrong position.

All writing must be legible and use proper spelling and grammar, or your assignment will be returned.