STARCHILD presents...

The Life Cycles of Stars

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This booklet, along with its matching poster, is meant to be used in conjunction with the StarChild website or CD-ROM.

http://starchild.gsfc.nasa.gov/

Index

National Mathematics and Science Standards
For the Activities in this Booklet

Space Squared - NSES Content Standard D for Grades 5-8
NCTM Grades 5-8 Standards 1,2,3,4,5,7

Nebular Nonsense (level 1) - NSES Content Standard D for Grades K-4
NCTM Grades K-4 Standard 1

Star Scrambles - NSES Content Standard D for Grades K-4
NCTM Grades K-4 Standard 1

Those Amazing Stars - NSES Content Standard D for Grades 5-8
NCTM Grades 5-8 Standard 1

Nebular Nonsense (level 2) - NSES Content Standard D for Grades 5-8
NCTM Grades 5-8 Standard 1

Space Connection - NSES Content Standard D for Grades K-4

Deep Space Doublets - NSES Content Standard D for Grades 5-8
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Space Spirals (level 2) - NSES Content Standard D for Grades 5-8
NCTM Grades 5-8 Standard 1

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NCTM Grades K-4 Standard 1

Star Life - NSES Content Standard D for Grades K-4

Star Signs - NSES Content Standard D for Grades 5-8

Star Sketches - NSES Content Standard D for Grades K-4
NCTM Grades K-4 Standard 9

STAR LIFE - LEVEL 1

In the list below you will find the steps in the life cycle of a massive star. The steps are not in order. Carefully cut each step out with scissors. Using the information you have learned about massive stars, place the strips in the order in which they occur in a star's life cycle.

1. A supernova occurs.

2. Nuclear fusion occurs which causes the star to glow.

3. If it is a massive star, a neutron star forms. If it is a super massive star, a black hole forms.

4. Gravity pulls hydrogen gas together to form a cloud.

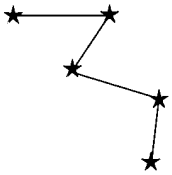
5. Iron, which acts as an energy sponge, forms within the star.

6. A red giant forms when the star's hydrogen level drops.

7. A main sequence star, which can live for millions or even billions of years, forms.

STAR SKETCHES - LEVEL 1

Long before the time of television, people told stories about the “pictures” they saw in the night sky. Many star groups were named for the people, animals, and objects our ancestors imagined when they looked at the stars. Use your imagination and other materials of your choice (crayons, stickers, glitter, etc.) to add to the star groups below. Create your own pictures using the stars as your guide.



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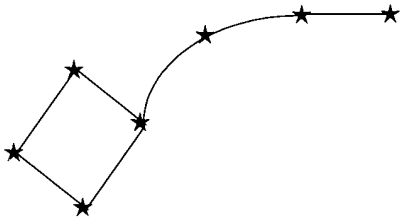
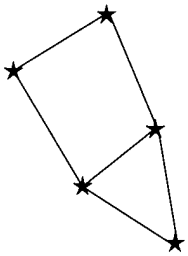
THE QUEEN



URSA MINOR
THE LITTLE BEAR



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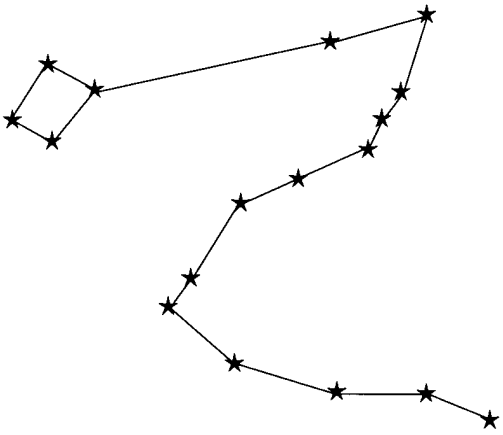
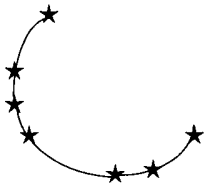
THE KING



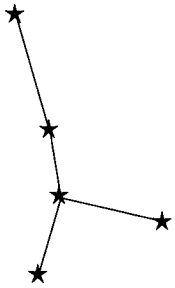
DRACO
THE DRAGON

STAR SKETCHES - LEVEL 1

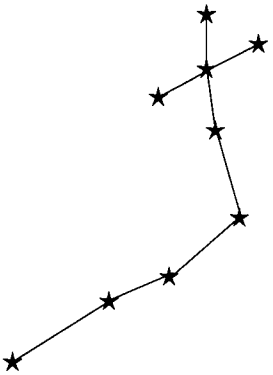


CORONA BOREALIS
THE NORTHERN CROWN

LEO
THE LION



CANCER
THE CRAB



SERPENS
THE SNAKE

NEBULAR NONSENSE - LEVEL 1

How many star terms can you find hidden in the puzzle below? Words may be written horizontally, vertically, diagonally, left to right, or right to left. Circle each word as you find it.

STAR TERMS:
star gas heat galaxy fuel light dust atoms cloud

R	F	U	E	L	R	A
Y	X	A	L	A	G	T
D	A	L	T	G	A	I
U	T	S	I	E	S	R
O	O	L	H	G	U	U
L	M	T	N	E	H	S
C	S	F	D	U	S	T

SPACE SPIRALS - LEVEL 1

Complete the word spiral by filling in the star term described by each numbered clue. Write the first letter of the first answer in the box numbered 1. Fill in one letter per box moving clockwise around the spiral. The first letter of each answer should be written in a numbered box. Be careful! Each new word may overlap the word before it by one or more letters.

EXAMPLE:

1. planet closest to Earth
2. name of the star in our solar system
3. opposite of south
4. opposite of cold

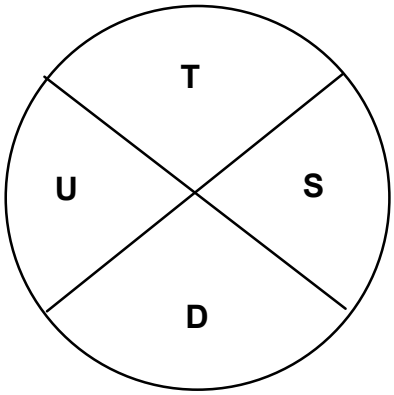
1 M	**A**	**R**	**2 S**
4 H	**O**	**T**	**U**
T	**R**	**0**	**3 N**

1. name given a new star
2. balls of gas giving off heat and light
3. powerful star explosion
4. force which pulls gas atoms together
5. the largest stars end their lives as _____ holes

1					**2**
	4				
		5			
					3

STAR SCRAMBLES - LEVEL 1

Words from the star text have been scrambled in the circles below. Your job is to unscramble the letters and write the correct word on the line under each circle.



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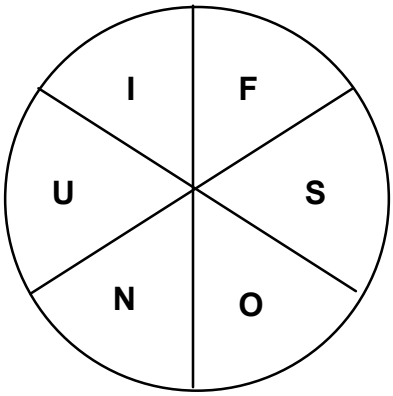

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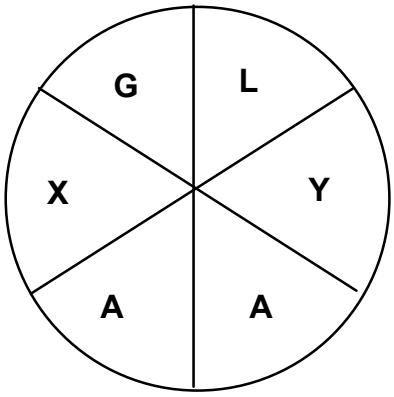

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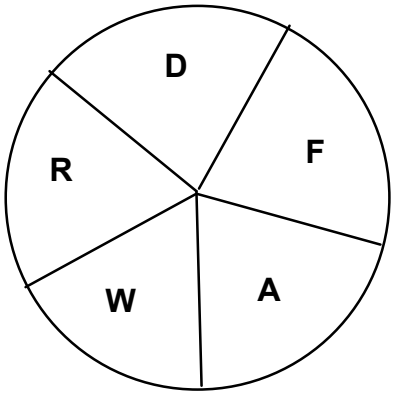

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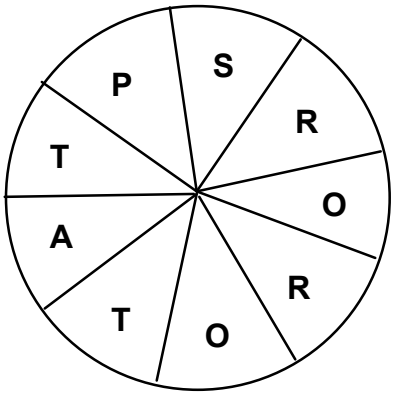
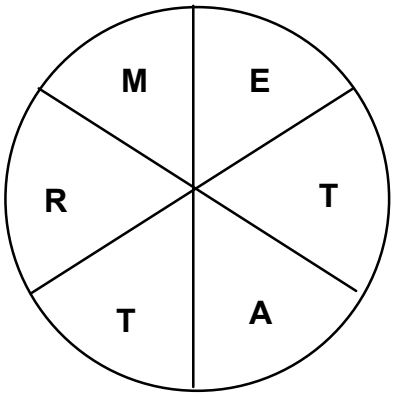
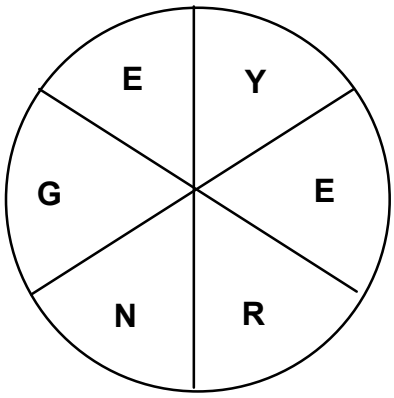
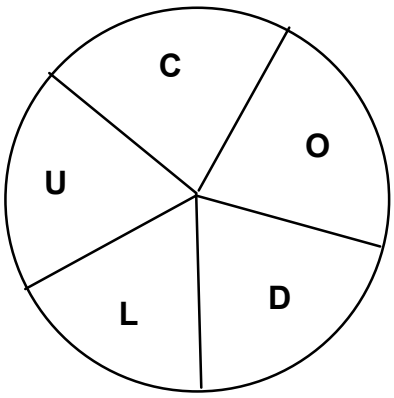
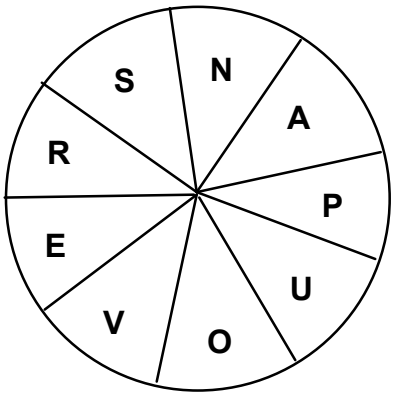
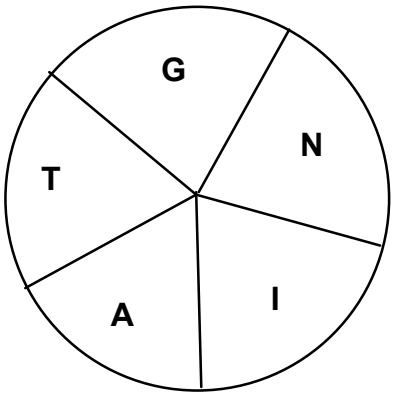

P
S
R
T
O
A
R
T
O


M
E
R
T
T
A


E
Y
G
E
N
R


C
O
U
L
D


S
N
A
R
P
E
V
U
O


G
N
T
A
I

SPACE SQUARED - LEVEL 2

Joseph L. Lagrange was a French mathematician who lived from 1736 to 1813. He made many contributions to the field of mathematics, but the most notable were the calculus of variations and the development of the metric system. Lagrange was also an amateur astronomer. His two fields of interest, mathematics and astronomy, have been combined in this activity.

Joseph Lagrange proved conclusively that the Four Square Theorem was indeed a valid theorem. This theorem states that every positive integer is expressible as a sum of four or fewer square numbers. A square number is attained when a number is multiplied times itself (example: 3 X 3 = 9; 9 is a square number).

Below you will find the distances between selected space objects. Your mission is to take the underlined number and express it as a sum of four or fewer square numbers. There may be more than one right answer. The first one is done for you.

1. Earth to Barnard's Star - 6 lightyears
   Solution: $1 + 1 + 4 = 6 \quad (1x1 + 1x1 + 2x2)$

2. Earth to Ursa Major - 7 lightyears

3. Sun to Earth (average) - 150 million kilometers

4. Venus to Earth (average) - 42 million kilometers

5. Mercury to Mars (average) - 170 million kilometers

6. Earth to Pleiades Star Cluster - 400 lightyears

7. Uranus to Neptune (average) - 1630 million kilometers

8. Earth to the star Vega - 27 lightyears

9. Earth to M51: Whirlpool Galaxy - 14 million lightyears

10. Center of the Milky Way Galaxy to the Sun - 30,000 lightyears

DEEP SPACE DOUBLETS - LEVEL 2

Charles Dodgson (1832-1898) was an English mathematician who also happened to be an excellent storyteller. Using the name of Lewis Carroll, he wrote children's books that were full of whimsical nonsense. Among Dodgson's literary creations are such works as Alice's Adventures in Wonderland and Through the Looking-Glass. He was also an excellent photographer.

In response to the pleas of some young friends, Dodgson created word puzzles which came to be known as "doublets." To solve a "doublet," you must change one word into another by going through a series of steps. You may change only one letter at a time. Each change must result in the formation of a new word. The first starry word has been done for you.

1. Change mass to dust: mass
   mast
   must
   dust

2. Change gas to Sun

3. Change star to hole

4. Change core to X-ray

5. Change heat to glow

6. Change fuse to burn

7. Change mass to life

8. Change spin to glow

9. Change mass to cool

10. Change red to hot

SPACE SPIRALS - LEVEL 2

Complete the word spiral by filling in the star term described by each numbered clue. Write the first letter of the first answer in the box numbered 1. Fill in one letter per box moving clockwise around the spiral. The first letter of each answer should be written in a numbered box. Be careful! Each new word may overlap the word before it by one or more letters.

EXAMPLE:

1. planet closest to Earth
2. name of the star in our solar system
3. opposite of south
4. opposite of cold

1 M	A	R	2 S
4 H	O	T	U
T	R	0	3 N

1. takes place at 15,000,000 °C
2. rapidly spinning stars which emit radio waves
3. glowing balls of gas
4. ring around the core of a star
5. clouds of dust and gases in a galaxy
6. form of energy coming from black holes
7. nuclear fusion converts hydrogen into this element
8. the fusion of helium atoms form these
9. they give off pulses of radio waves
10. area of the cloud in which nuclear fusion takes place

1								
				5				
	8				10			
								2
				9			6	
4				7				
				3				

NEBULAR NONSENSE - LEVEL 2

How many star terms can you find hidden in the puzzle below? Words may be written horizontally, vertically, diagonally, left to right or right to left. Circle each word as you find it.

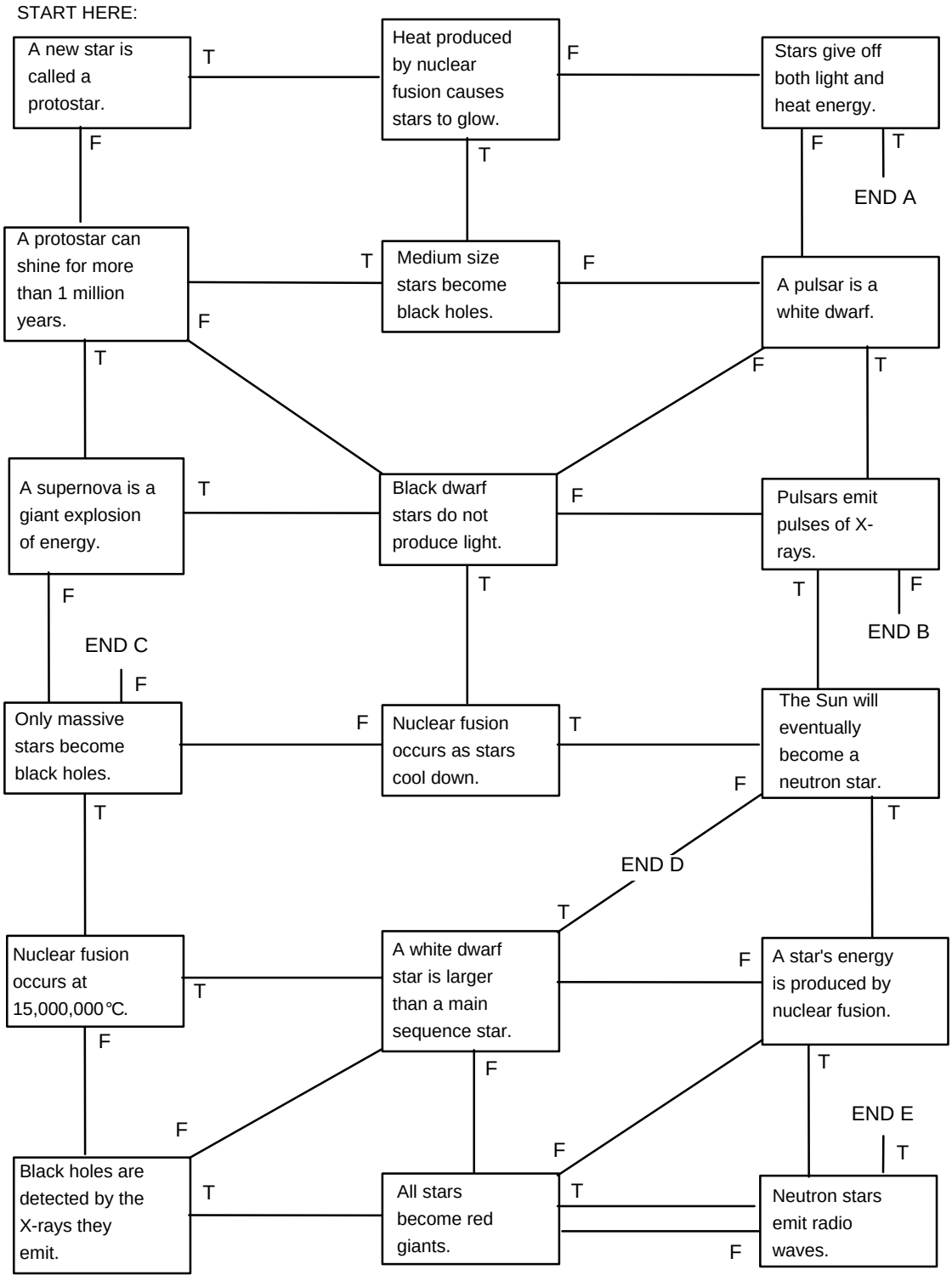
Star Terms:

hot, atoms, nebula, supernova, neutron, red giant, cycle, sphere, energy, fusion, core, galaxy, hydrogen, evolve, gas, cloud, glow, x-ray

N G F C E L S I U A A
E N T U L S D W C I L
B O N A S S P E O G U
U R A I H I M H R D B
L T I G Y E O O E E E
E U G A D T V N T R N
L E D L R O E L W A E
C N E A O R D U O L C
Y A R X G A S Y L V U
C T O Y E N A I G X E
A A V O N R E P U S N

THOSE A-MAZE-ING STARS - LEVEL 2

Use what you have learned about stars to find your way through the maze below. Begin at the start box, carefully read the statement in each box and decide if it is true or false. You will move from box to box by following the directional arrows (T = TRUE, F = FALSE). Continue to follow the arrows until you reach the true end of the maze (END E). All other exits are incorrect. If you exit at A, B, C, or D, retrace your steps to find where you got off track.



Solutions

STAR LIFE ANSWER KEY - LEVEL 1

1. Gravity pulls hydrogen gas together to form a cloud. (4)

2. Nuclear fusion occurs which causes the star to glow. (2)

3. A main sequence star, which can live for millions or even billions of years, forms. (7)

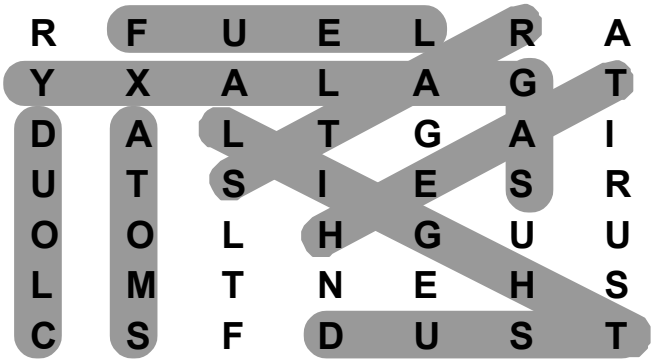
4. A red giant forms when the star's hydrogen level drops. (6)

5. Iron, which acts as an energy sponge, forms within the star. (5)

6. A supernova occurs. (1)

7. If it is a massive star, a neutron star forms. If it is a super massive star, a black hole forms. (3)

NEBULAR NONSENSE ANSWER KEY - LEVEL 1



SPACE SPIRALS ANSWER KEY - LEVEL 1

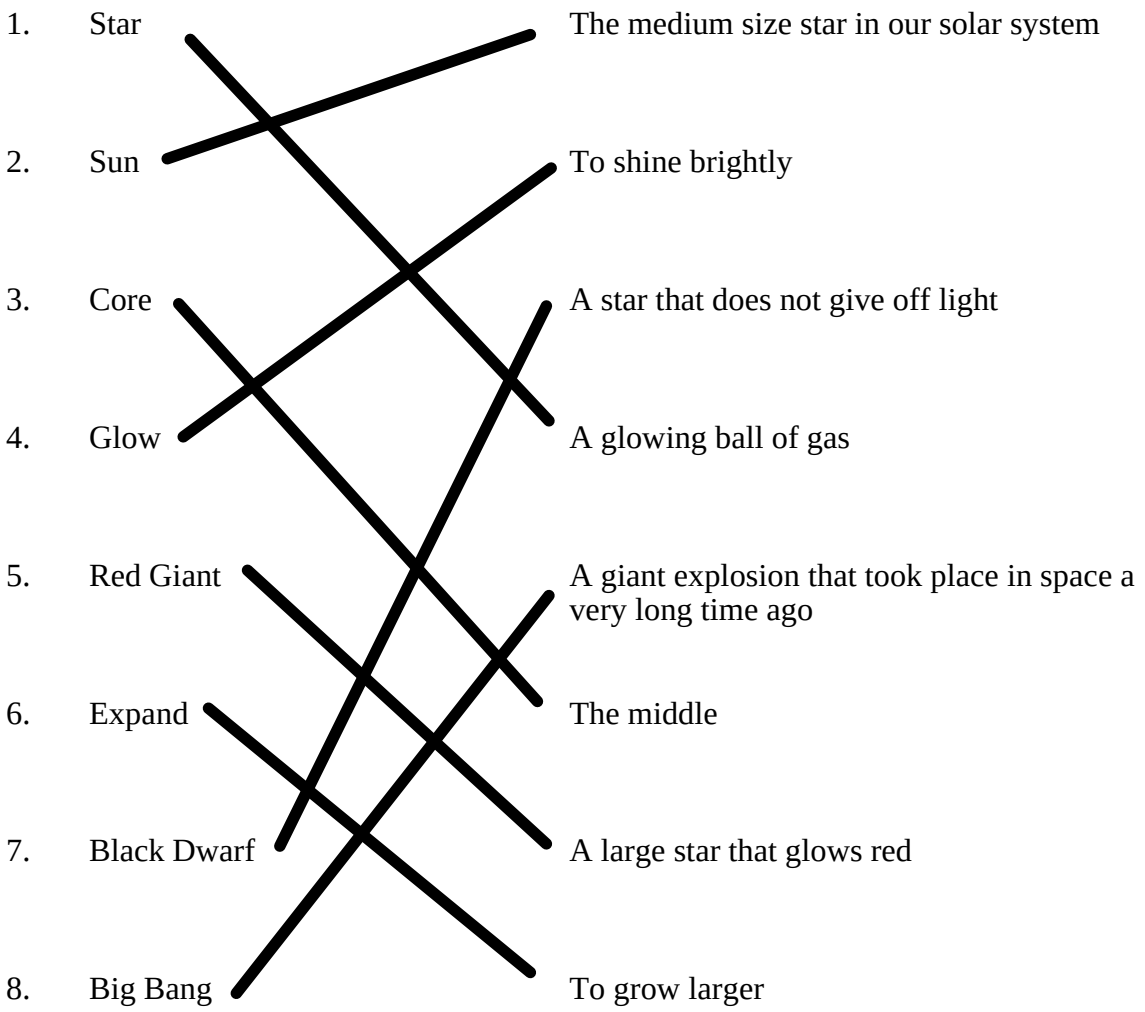
1 p	r	o	t	o	2 s
a	4 g	r	a	v	t
v	a	c	k	i	a
o	l	5 b	y	t	r
n	r	e	p	u	3 s

STAR SCRAMBLES ANSWER KEY - LEVEL 1

1. DUST
2. FUSION
3. GALAXY
4. DWARF
5. PROTOSTAR
6. MATTER
7. ENERGY
8. CLOUD
9. SUPERNOVA
10. GIANT

SPACE CONNECTION ANSWER KEY - LEVEL 1

Draw a line to connect each word to the group of words that best describes it.



8. spin
   spit
   slit
   slot
   slow
   glow

9. mass
   moss
   most
   molt
   bolt
   colt
   coat
   coal
   cool

10. red
    led
    let
    lot
    hot

SPACE SPIRALS ANSWER KEY - LEVEL 2

1 n	u	c	l	e	a	r	f	u
t	a	r	y	5 n	e	b	u	s
e	a	r	b	o	n	a	l	i
n	8 c	a	r	s	10 c	t	a	o
a	m	s	e	r	o	o	e	2 n
l	u	l	u	9 p	s	m	6 x	e
4 p	i	l	e	7 h	y	a	r	u
s	r	a	t	3 s	n	o	r	t

STAR SIGNS ANSWER KEY - LEVEL 2

A. Gemini — L The Water Carrier

B. Cancer — B The Crab

C. Aries — F The Goat

D. Libra — A The Twins

E. Ursa Major — H The Dragon

F. Capricornus — I The Winged Horse

G. Leo — N The Scorpion

H. Draco — J The Bull

I. Pegasus — M The Archer

Resources

Web Sites

- http://web.syr.edu:80/~jmlacivi/index.html
  This site covers the birth of a star from particles of gas and dust, the life cycle of the star, the grouping of stars into clusters and galaxies, and the eventual death of a star after millions of years.

- http://oposite.stsci.edu/pubinfo/amazing-space.html
  Part of the Hubble Space Telescope's Amazing Space site with interactive activities for kids. The current one under development is "Stars:birth, life, death, and rebirth."

Books

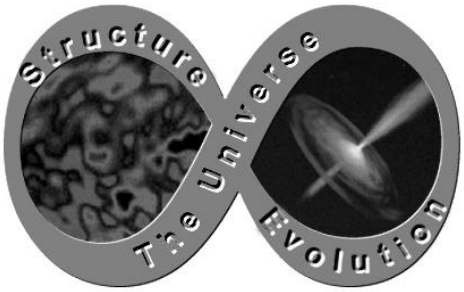
- *Universe* by William J. Kaufmann III, Freeman and Company, 1994. This book comes highly recommended from both students, and scientists. It explains many concepts in astronomy from cosmology to high-energy astrophysics, including information on stars (see chapter 18). Intended for the upper high school student with a strong science background and interest, or the undergraduate science major taking a basic astronomy course. A useful resource for teachers on all levels.

- *The Young Oxford Book of Astronomy* by Jacqueline & Simon Mitton, Oxford University Press, Inc., 1995. This book explains many concepts in astronomy from the Solar System, galaxies and the Universe. Intended for the middle or high school student.

- *How Far is a Star?* by Sidney Rosen, Carolrhoda Books, Inc.,1992. With cartoon characters leading the way, you'll find out much about the lives of stars, how big they are, and how far away they are in this question-and-answer book. Intended for students in elementary school.

About this Poster

The images on this poster are all artists' renditions. The neutron star is depicted to emphasize its powerful magnetic field. The black hole image shows the large accretion disk and jets surrounding the black hole, which cannot be seen.



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NASA Goddard Space Flight Center
Laboratory for High Energy Astrophysics