**Unit Two**

**Look Up at the Stars**

**Suggested Teaching Steps**

Lead-in

Text A

* Word & Sentence Study
* Structure Study

After-reading

Additional Materials

**Lead-in**

**Directions: Please watch the video clip and answer the questions.**

l . who was the speaker? what do you know about him?

2 . According to the speaker, what are the ambitious experiments planned for the future?

**Tips:**

1. Stephen Hawking ( l942 — 20l8) was the former Lucasian Professor of Mathematics at the University of Cambridge and author of *A Brief Hislory of Time* which is an international bestseller.
2. We will map the positions of billions of galaxies, better understand our place in the universe, and continue to explore space.

**Text A The Universe Gives up Its Deepest secret**

0ne of the greatest mysteries of the universe is about to be unraveled with the first detailed, threedimensional map of dark matter — the invisible material that makes up most of the cosmos.

Astronomers announced yesterday that they have achieved the apparently impossible task of creating a picture of something that has defied every attempt to detect it since its existence was first postulated in l933.

Scientists have known for many years that there is more to the universe than can be seen or detected through their telescopes but it is only now that they have been able to capture the first significant 3D image of this otherwise invisible material.

Unlike the ordinary matter of the planets, stars and galaxies, which can be seen through telescopes or detected by scientific instruments, nobody has seen dark matter or knows what it is made of, though calculations suggest that it is at least six times bigger than the rest of the visible universe combined.

A team of 70 astronomers from Europe, America and Japan used the Hubble Space Telescope to build up a picture of dark matter in a vast region of space where some of the galaxies date back to half the age of the universe — nearly 7 billion years.

They used a phenomenon known as gravitational lensing, first predicted by Albert Einstein, to investigate an area of the sky nine times the size of a full moon. Gravitational lensing occurs when light from distant galaxies is bent by the gravitational influence of any matter that it passes on its journey through space.

The scientists were able to exploit the technique by collecting the distorted light from half a million faraway galaxies to reconstruct some of the missing mass of the universe which is otherwise invisible to conventional telescopes.

“We have, for the first time, mapped the large-scale distribution of dark matter in the universe,” the leading scientist said. “Dark matter is a mysterious and invisible form of matter, about which we know very little, yet it dominates the mass of the universe.”

One of the most important discoveries to emerge from the study is that dark matter appears to form an invisible scaffold or skeleton around which the visible universe has formed.

Although cosmologists have theorized that this would be the case, the findings are dramatic proof that their calculations are correct and that, without dark matter, the known universe that we can see would not be able to exist.

“A filamentary web of dark matter is threaded through the entire universe, and acts as scaffolding within which the ordinary matter — including stars, galaxies and planets — can later be built,” the leading scientist said. “The most surprising aspect of our map is how unsurprising it is. Overall, we seem to understand really well what happens during the formation of structure and the evolution of the universe,” he said.

The three-dimensional map of dark matter was built up by taking slices through different regions of space; much like a medical CT scanner builds a 3D image of the body by taking different X-ray “slices” in two dimensions.

Data from the Hubble telescope was supplemented by measurements from telescopes on the ground, such as the Very Large Telescope of the European Southern Observatory and the Japanese Subaru telescope.

Details of the dark matter map were released yesterday at the annual meeting of the American Astronomical society in Seattle and published online by the journal *Nature*. The map stretches half way back to the beginning of the universe and shows that dark matter has formed into “clumps” as it collapsed under gravity. Other matter then grouped around these clumps to form the visible stars, galaxies and planets.

“The 3D information is vital to studying the evolution of the structures over cosmic time,” said another famous scientist.

Astronomers have compared the task of detecting dark matter to the difficulty of photographing a city at night from the air when only street lights are visible.

Scientists said the new images were equivalent to seeing a city, its suburbs and country roads in daylight for the first time. Major arteries and intersections become evident and a variety of neighborhoods are revealed.

“Now that we have begun to map out where dark matter is, the next challenge is to determine what it is, and specifically its relationship to normal matter,” the leading scientist said. “We have answered the first question about where the dark matter is, but the ultimate goal will be to determine what it is.”

Various experiments on Earth are under way to try to find out what dark matter is made of. One theory is that it is composed of mysterious sub-atomic particles that are difficult to detect because they do not interact with ordinary matter and so cannot be picked up and identified by conventional scientific instruments. Comparing the maps of visible matter and dark matter has already pointed to anomalies that could prove critical to the understanding of what constitutes dark matter.

**Detailed Study**

1. (*Para.* 2) Astronomers announced yesterday that they have achieved the apparently impossible task of creating a picture of something that has defied every attempt to detect it since its existence was first postulated in l933.

【译文】 昨天，天文学家声明：他们已完成了在此之前看似不可能完成的任务—— 自 l933 年假设暗物质存在以来，人们一直尝试构建它的图像，但每次均以失败告终。

此句是由 “that”引导的宾语从句，在宾语从句中是由“since”引导的时间状语从句。“since”意为“自 …… 以来”。

e.g. It was the first time Id won since I learnt to play chess.

“since”作为副词，有“后来”之意：

e.g. She moved to London last May and has since got a job at a newspaper.

“since”作为介词，意为“自从”：

e.g. Education has made rapid progress since liberation.

**defy *vt.***

(l) to present obstacles to prevent sth. 使 ……成为不可能，使 ……落空

e.g. The beauty of the scene defies description.

(2) to refuse to obey or show respect for sb. in authority, a law, a rule, etc.

违(反)抗，藐(蔑)视

e.g. I wouldnt have dared to defy my teachers.

Hundreds of people today defied the ban on political gatherings.

**defiance *n.***

e.g. His defiance of the law cost him dearly.

**detect: vt.** to notice or discover sth., especially sth. that is not easy to see, hear, etc. 发现，察觉，探测

e.g. Many forms of cancer can be cured if detected early.

Dan detected a change in her mood.

**detectable: adj.** 可察觉的，易发现的

e.g. The noise is barely detectable by the human ear.

1. (*Para.* 3) ...but it is only now that they have been able to capture the first significant 3D image of this otherwise invisible material.

【译文】但直到现在，科学家们才首次捕捉到了这一本不可见的物质的三维图形。

本句是强调句，强调时间。

It is ( was ) + 状语 + that + 句子，此结构用来强调状语，充当状语的可以是单词、词组或者从句，可以强调时间、地点、时间状语从句、地点状语从句和主语从句。

It was yesterday that I bought the book in the bookstore. (强调时间)

It was in the bookstore that I bought the book yesterday. (强调地点)

It was only when I badly needed the book that I bought it yesterday. (强调时间状语从句)

It was because (不用 Since, why, as) I badly needed the book that I bought it yesterday. (强调原因状语从句)

It is what you do that is important. (强调主语从句)

**capture *vt.***

(l) to succeed in recording, showing, or describing a situation or feeling, using words or pictures 捕捉，抓取，获得

e.g. I closed my eyes tightly to capture the picture firmly in my mind.

(2) to catch a person and keep him/her as a prisoner 俘虏 (获)

e.g. Government troops have succeeded in capturing the rebel leader.

**capture: n.** the act of capturing sb./sth. or of being captured 俘 (捕) 获，占领

e.g. The soldier played dead to escape capture by the enemy.

**otherwise *adv.***

(l) except for what has just been mentioned 除此以外

e.g. He was tired but otherwise in good health.

This spoiled an otherwise excellent piece of work.

(2) in another or a different way 用别的方法，不同地

e.g. we’ll get there somehow, by boat or otherwise.

**otherwise  *conj.***if conditions were different; if not … 否则，不然

e.g. Put the cap back on the bottle, otherwise the juice will spill.

We must run, otherwise we’ll be too late.

1. (*Para.* 8) Dark matter is a mysterious and invisible form of matter, about which we know very little, yet it dominates the mass of the universe.

【译文】暗物质占据着宇宙的大部分，它是一种神秘又难观测到的物质，我们对其所知甚少。

**dominate  *vt.***

(1) to control or have a lot of influence over sb./sth., often in an unpleasant way 支配，统治

e.g. Spain once dominated the seas.

In television, three networks clearly dominate the market of American viewers.

(2) to be the most important or noticeable feature of sth. 在……中占主要地位

e.g. The train crash dominated the news.

Sports, though important, should not dominate our schools.

**domination *n.*** 支配，统治，控制

e.g. She has been under the domination of her father since childhood.

4.( Para. 10) Although cosmologists have theorized that this would be the case, the findings are dramatic proof that their calculations are correct and that, without dark matter, the known universe that we can see would not be able to exist.

【译文】虽然宇宙学家已从理论上阐明了暗物质的存在，但这组发现明确地证实了宇宙学家的测算是正确的，同时也证明了如果没有暗物质，我们已知的这个世界就不可能存在。

本句为“although”引导的让步状语从句，主句为“that”引导的同位语从句补充和说明“proof ”。

**theorize *vt.***

(1) to think of a possible explanation for an event or fact 推理

e.g. Researchers theorize that there was once a common language for all humanity.

It is a grave mistake to theorize before one has data.

(2) to form a theory or theories about sth. 建立理论，理论化

e.g. scientists have theorized about dark matter for about seventy years.

**dramatic *adj.***

(l) exciting and impressive 激动人心的，给人印象深刻的

e.g. some of the most dramatic events in American history happened here.

Her opening words were dramatic.

(2) great and sudden 剧烈的

e.g. The government is alarmed by the dramatic increase in violent crime.

(3) connected with the theater or plays 戏剧性的

e.g. A new dramatic production is planned at the school after the start of next semester.

1. (*Para.* 12) The three-dimensional map of dark matter was built up by taking slices through different regions of space; much like a medical CT scanner builds a 3D image of the body by taking different x-ray “slices” in two dimensions.

【译文】暗物质的三维图形是通过宇宙空间不同区域的横切面构建而成，它与医学上的 CT 扫描仪通过 X射线获取人体二维截面以形成人体的三维成像非常相似。

**like *conj.*** in the same way as 正如，像……那样

e.g. No one else can score goals like he can!

Don’t talk to me like you talk to a child.

1. (*Para.* 14) The map stretches half way back to the beginning of the universe and shows that dark matter has formed into “clumps” as it collapsed under gravity.

【译文】该图形追溯到了宇宙发展的中期，展示了暗物质在重力作用下分裂而形成的“暗物质团”。

**stretch *v.***

(1) to make sth. Longer, wider, or looser 拉长，伸展

e.g. Is there any way of stretching shoes?

(2) to extend or reach, in either time or space 延伸

e.g. The wheat field stretched to the horizon.

**stretch *n.***act of stretching or the state of being stretched 伸展，张开

e.g. The dog woke up. had a good stretch and wandered off.

**collapse *v.***

(1) to fall down or fall in suddenly, often after breaking apart 倒(坍)塌

e.g. The roof collapsed under the weight of snow.

(2) to quickly get worse, down to a very low point 病倒，昏厥

e.g. His health collapsed because of overwork.

**collapse *n.*** 倒塌，崩溃

e.g. The collapse of the building caused no casualties.

1. (*Para.* 16) Astronomers have compared the task of detecting dark matter to the difficulty of photographing a city at night from the air when only street lights are visible.

【译文】天文学家认为，探测暗物质的任务如同在只有街灯的夜间从空中拍摄城市景观一样艰难。

“compare … to …”意为“把…… 比作 (喻为)”，“compare … with …”意为“与……相比”。

e.g. The critics compared his work to that of Martin Amis.

We carefully compared the first report with the second.

My own problems seem insignificant compared with (in comparison to) other peoples.

1. (*Para.* 18) Now that we have begun to map out where dark matter is, the next challenge is to determine what it is...

【译文】既然我们已开始勾勒暗物质所处的位置，那下一个挑战就是搞清楚它是什么……

**“now that”**引导让步状语从句，意为“既然，由于”。

e.g. Now that you are a university student, you should learn to be independent of your parent help.

Now that I am free, I can enjoy music for a while.

1. (*Para.* 19) Comparing the maps of visible matter and dark matter has already pointed to anomalies that could prove critica1 to the understanding of what constitutes dark matter: Comparisons made between visible matter maps and dark matter maps have shown some unusual aspects. which could prove important for discovering what dark matter is made up of.

【译文】对可见物质和暗物质的图片比较已证明了暗物质的独特之处，这对于理解暗物质的构成很关键。

**critical  *adj.***

(1) extremely important because a future situation will be affected by it 危急时刻的，决定性的，关键的

e.g. That was a critical time in the nations history.

(2) ( ~ of sb./sth.) expressing disapproval of sb./sth. and saying what you think is bad about them 批评(判)的，评论性的

e.g. He received serious critical comments on his inefficiency at work.

**constitute  *vt.***

(1) to be the parts that together form sth. 组(构)成

e.g. There are many disparate parts that together constitute a car.

(2) to officially form a group or organization 正式成(建)立

e.g. The committee had been improperly constituted, and therefore had no legal power.

**Structure Study**

**Summary of the Text**

**Directions: The text can be divided into four parts. Fi11 in the b1anks with appropriate words from the text to complete the main idea of each part.**

|  |  |  |
| --- | --- | --- |
| **Parts** | **Paragraphs** | **Main Ideas** |
| Part One | Paras. l—2 | Astronomers announced that they have been able to l) **capture** the first  significant 3D 2) **image** of dark matter which is otherwise 3) **invisible**. |
| Part Two | Paras. 3—7 | 70 4) **astronomers** from different countries exploited 5) **gravitational lensing**  by collecting the distorted light from half a million faraway galaxies to 6) **reconstruct** some of the missing mass of the universe but nobody knows  what it is made of even though it 7) **dominates** the mass of the universe. |
| Part Three | Paras. 8—16 | The scientists want to show what the dark matter looks like. 8) **0verall**, it appears to form an invisible scaffold or 9) **skeleton** within which the ordinary  matter — including stars, galaxies and planets — can later be built. |
| Part Four | Paras. 17—19 | The scientists have begun to map out where dark matter is, but our l0) **ultimate** goal will be to determine what it is. |

**Directions: Answer the following questions according to the text.**

l) Were the many scientists, who have tried to detect a picture of the invisible material since its existence was first postulated, successful?

No. It has defied every attempt to detect it since its existence was first postulated in l933.

1. How did scientists use the phenomenon known as gravitational lensing, first predicted by Albert Einstein, to reconstruct some of the missing mass of the universe?

The scientists were able to exploit this technique by collecting the distorted light from half a million faraway galaxies to reconstruct some of the missing mass of the universe.

1. How did the leading scientist describe the dark matter?

It looks like a filamentary web, which is threaded through the entire universe, and acts as scaffolding within which the ordinary matter — including stars, galaxies and planets — can later be built.

1. Is the study of the 3D image important? why or why not?

Yes. The 3D information is vital to studying the evolution of the structures over cosmic time.

1. According to the text, why do scientists make efforts to detect dark matter? Because without dark matter, the known universe that we can see would not be able to exist.

**After-reading**

**Key to Exercises — Vocabulary**

**1.**

1) skeleton 2) released 3) captured 4) collapsed 5) ultimate

6) intersection 7) otherwise 8) equivalent 9) defy 10) distorting

**2.**

1) The desks are arranged in a U-shape, so the teacher can interact easily with the students.

2) Detectives are trying to build up a picture of the kidnapper.

3) Using a telescope, Galileo discovered stars that were invisible to the naked eye.

4) Our partnership dates back to l960.

5) The sun emerged from behind the clouds.

6) It is vital to be honest with your children.

7) The research project has only been under way for three months, so its too early to evaluate its success.

8)The British Parliament is composed of the House of Commons and the House of Lords.

**Key to Exercises — Structure**

**1.**

1) Now that we know each other quite well

2) Now that the kids have left home

3) Now that you have grown up and become a university student

4) Now that Ive paid the tax demanded and the childrens school fees

5) Now that prices are rising so fast

**2.**

1) This bridge over the river is three times the length of that one.

2) Our parents bedroom is twice the size of mine.

3) This swimming pool is four times the width of the one under construction.

4) It is reported that the mountain that the mountaineers climbed yesterday is twice the height of Taibai Mountain.

5) We have to admit that this well is five times the depth of that one.

**Key to Exercises — Cloze**

1. superior 2) approach 3) bluntly 4) egos 5) conquered

6) stable 7) stagger 8) imperfections 9) signaling 10) initiate

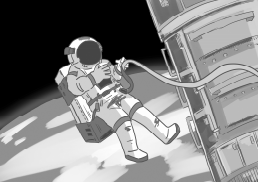
**Key to Exercises — Translation**

中国最新的载人航天飞船上周四与空间站对接成功，三名宇航员登上空间站，那里将是他们下周接下来一周的居住地。神舟十号对接空间实验将由自动化控制。进入太空实验室之后船员们换上了他们在空间内的蓝色连身衣。他们将在空间实验室中停留 l2天。期间，宇航员们将进行手动对接练习并开展科学实验，他们还将提供一系列科学讲座，提高中国太空计划在青少年人群中的普及程度。

**After-reading Activity One: Talking about Pictures**

**Directions: From our small world, we have gazed upon the cosmic ocean for untold thousands of years. But the years since l957 have amounted to a golden age of space exploration. Use the following table to help you share what you know with your classmates.**





|  |  |  |  |
| --- | --- | --- | --- |
| Event | Time | Crew members | Significance |
|  |  |  |  |
|  |  |  |  |

**After-reading Activity Two: Pair Work**

|  |  |
| --- | --- |
| Picture of ET | ET’s Super Power |
|  |  |

**Directions: Do you believe in the existence of intelligent extraterrestrial life? If yes, what does it look like? What kinds of super power does it have? Picture the image of ET in your mind in the space provided below and list the super power it possesses. Then plan a one-day tour for your ET friend on the earth.**

|  |  |  |
| --- | --- | --- |
| Plan of a One-day Tour | | |
| Time | Arrangements | Reasons |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**After-reading Activity Three: Discussion**

**Directions: Break up into groups and discuss the following questions.**

Every year, billions of dollars are spent by the world’s space agencies, but does this money bring us any benefit? Is space exploration a waste of money or should we pull the plug and spend the money elsewhere?

**Additional Materials**

**Activity One**

**Directions: How much do you know about the universe that we are living in? Read the statements below and decide whether these facts about the universe are true or false.**

**Reference answers:**

( T ) l. The universe is expanding.

( F ) 2 . The sun is a giant compared to other stars.

The sun is a medium sized star about halfway through its life cycle.

( T ) 3 . The laws of physics break down at the center of a black hole.

( T ) 4 . There are an infinite number of parallel universes.

( F ) 5 . There are only a few known galaxies that exist in the universe.

There are actually hundreds of billions of galaxies known in our universe.

**Activity Two**

**Directions: There are various Chinese legends about the origin of the universe. In groups of 4 or 5, use the key words in the table below to tell the story of Pangu and Nüwa.**

|  |  |
| --- | --- |
| ***Pangu separates the sky from the Earth*** | ***Nüwa Creates Humans*** |
| darkness and chaos  blurred entity  vast “egg”  to crack | mud  to make by hand  to fling a rope  to populate the earth |

**Tips:**

**Pangu Separates the Sky from the Earth**

China has a history longer than that of any other present-day nation, containing a plethora of myths and legends. The first figure that created the world in Chinas history was named Pangu.

According to legend, in the beginning, there was only darkness and chaos, and the sky and the earth were one blurred entity. This vast “egg” as the Chinese call it, was subject to two opposing forces or principles. The interaction between the two forces: the *yin* ( passive or negative female principle) and the *yang* ( active or positive male principle) gave birth to Pangu, causing the eggs shell to crack.

The separation of the sky and the earth took l8,000 years to complete: The *yang*, which was light and pure, rose to become the sky; the *yin*, which was heavy and murky, sank to form the earth. Between the sky and the earth was Pangu, who underwent nine changes every day: his wisdom is greater than that of the sky and his ability greater than that of the earth. Every day the sky rose ten feet, the earth became ten feet thicker and Pangu grew ten feet taller. Another l8,000 years passed and the sky was very high; the earth, dense and Pangu, extremely tall. His body then dissolved and his head became the mountains; his breath, the wind and clouds; his voice, the thunder; his left eye, the sun and his right eye, the moon. Pangus beard became the stars; his four limbs, the four quadrants of the globe; his blood, the rivers and his veins and muscles, the layers of the earth. His flesh became the soil; his skin and hair, the trees and plants; his semen, pearls; his marrow, precious stones and his sweat turned into rain. All in all, Pangu and the universe became one.

**Nüwa Creates Humans**

In Chinese mythology, Nüwa is the goddess of order who created humans. According to legend, Nüwa came to the earth before there were any human.

Nüwa became lonely and decided to make copies of herself from mud in a pool. The figures she created came to life and wandered off to populate the earth. After a while, Nüwa realized that it would take too long to fill the earth with people if she made each one by hand. so she took a rope, dipped it into the mud, and flung the drops of mud in all directions. Each drop became a separate human being.

**Background Information**

1. **Dark Matter**

Learning about dark matter helps determine the shape of the universe, because the shape of the universe depends on the kind of stuff in it. Moreover, because dark matter comprises such a large amount of the universe, understanding its nature and behavior are integral. Fritz Zwicky was the pioneer in this field. In l933, at the California Institute of Technology, the Swiss astrophysicist Zwicky was the first to theorize dark matter after he observed that there was 400 times the mass in the Coma cluster of galaxies than there “should” have been or that he had expected there to be. According to Zwicky, there must have been something that couldn’t be seen that accounted for the rest of this mass. Furthermore, he came to another conclusion by looking at groups of galaxies tens of millions of light-years away from one another. Zwicky observed that their relative speeds were much too great for them to be held together by the gravitational attraction of the visible matter alone, and that therefore, there must have been something else holding them together. He called this something else “invisible matter” or “dark matter”. And then other discoveries sprang forth.

In l950, a woman named Vera Rubin made another startling discovery. Newton’s laws predicted that bodies orbiting around a center move more slowly the farther they are from that center. Instead, Rubins conclusions contradicted Newtonian laws. she built on the theories of Zwicky to discover that galaxies showed an “extra motion”: by examining galactic light signatures, she found that bodies orbiting around the outskirts of galaxies traveled at approximately the same speed as the bodies orbiting near the center of a galaxy, therefore some other matter had to exist in the outskirts, some matter that we couldn’t see, that was acting upon the visible bodies. The punch line was dark matter.

Over the second half of the 20th Century many other important contributions to theories of dark matter have been made by the likes of Mordehai Milgrom and Yakov Zel’dovich. However, the most important thing to remember in learning about the history of dark matter theories is that there is always room for improvement, always a new way to think about things, always a new way to widen our minds to crucial questions about the universe.

**2. Hubble Space Telescope**

The Hubble Space Telescope (HST) is a space telescope that was carried into orbit by the space shuttle Discovery in April l990. It is named after the American astronomer Edwin Hubble. Although not the first space telescope, the Hubble is one of the largest and most versatile, and is well-known as both a vital research tool and a public relations boon for astronomy.

The Hubble is the only telescope ever designed to be serviced in space by astronauts. To date, there have been four servicing missions. servicing Mission l took place in December l993 when Hubble’s imaging flaw was corrected. servicing missions 2, 3A, and 3B repaired various sub-systems and replaced many of the observing instruments with more modern and capable versions.

**3. European Southern Observatory**

The European Southern Observatory (ESO, whose official name is the European Organization for Astronomical Research in the southern Hemisphere), is an intergovernmental research organization for astronomy, composed and supported by fourteen countries from Europe. Created in l962, to provide state-of-the-art facilities and access to the southern sky to European astronomers, it is famous for building and operating some of the largest and most technologically advanced telescopes in the world, such as the New Technology Telescope (NTT) , the telescope that pioneered active optics technology, and the VLT (Very Large Telescope), consisting of four 8-meter class telescopes and four 1.8-m Auxiliary Telescopes.

Its numerous observing facilities have made possible many astronomical discoveries, and the production of several astronomical catalogues. Among the more recent discoveries is the discovery of the farthest gamma-ray burst and the evidence for a black hole at the centre of our galaxy, the Milky Way.

**4. Subaru Telescope**

It is the 8.2 m flagship telescope of the National Astronomical Observatory of Japan, located at the Mauna Kea Observatory on Hawaii. It is named after the open star cluster known in English as the Pleiades. It is the largest telescope in the world to use a single mirror as its primary mirror.

**5. Gravitational Lensing**

Light traveling billions of light years to reach us is bent by clumps of matter along its path. Albert Einstein predicted this so-called gravitational lensing when he characterized gravity as the curvature of space-time.

One way to understand gravitational lensing is to picture space as a rubber sheet. The sheet is deformed, or curved, when something heavy, like a bowling ball, is placed on it. If something passes nearby — like a rolling marble — the trajectory is deflected, or bent.

This deflection works on light as well. If we look towards a massive object, the light coming from behind may be focused or spread out. In this way, galaxies, which have masses billions of times the mass of our sun, distort the background universe.

The most obvious examples of gravitational lensing are when the light from a quasar is broken up into multiple images, or when the shape of a galaxy is stretched out. These cases are deemed strong lensing.

**6. American Astronomical Society**

The American Astronomical society (AAS, sometimes said “double-A-S”) is a US society of professional astronomers and other interested individuals, headquartered in Washington, DC. The basic objective of the AAS is to promote the advancement of astronomy and closely related branches of science. Its secondary purposes include enhancing astronomy education and providing a political voice for its members through lobbying and grassroots activities.