宇宙时间线

Cosmological Time Line

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目标
Goals

- 用时间线可视化宇宙的历史
- 了解形成生命所必需的重要过程。
- 了解生命如何适应各种不同的条件

- Visualize the history of the Universe with a time line
- Understand the important processes that were necessary to arrive at the formation of life.
- Understand the adaptation of life to very varied conditions

活动1：时间表

Activity 1: Timeline

宇宙的开始，大爆炸，大约在138亿年前，也就是 13.8 10^9年前

1米= 10^9年

1毫米= 1百万年

时间表的 13.8米

The beginning of the universe, the Big Bang, had place about 13.8 billion years ago, that is, 13.8 10^9 years ago

1 meter = 10^9 years

1 mm = 1 million years

Timeline of 13.8 meters

活动1：时间表

t=0 秒 (13.8 10^9年前开业 宇宙，大爆炸)
(13.8 10^9 years ago beginning of the Universe, the Big Bang.)

10^{-45} 秒 结束普朗克时代 (也不是相对论爱因斯坦)
End Planck Era (N.B. Relativity Einstein

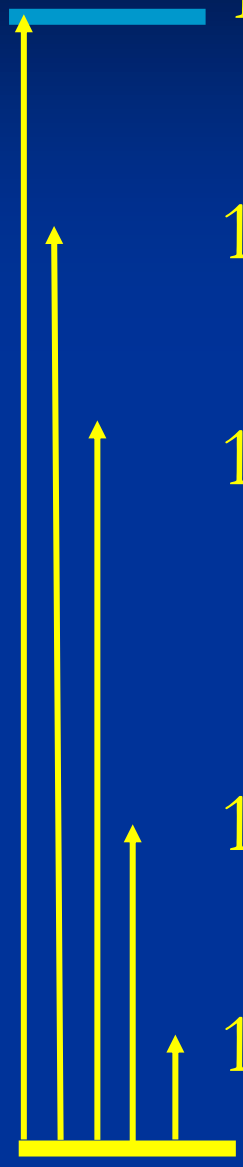
10^{-35} 秒 膨胀 (指数膨胀宇宙) Inflation (Exponential Expansion Universe)

10^{-6} 秒 原始汤 (各种基本粒子) Primordial Soup (Various Elementary Particles)

3 分钟 “H” 的原生核合成 Primordial Nucleosynthesis of “H”

由于1毫米= 10^6年，因此无法在时间线上表示该属性)
This period cannot be represented on the time line as 1 mm = 10^6 years)

活动1：时间表 Activity 1: Timeline



13.80 10^9 年大爆 years Bing Bang

100毫米

13,70 10^9 岁第一原始元素 years 1st primordial elements

100毫米

13,60 10^9 岁第一星 years first stars

岁第一水分子 years first wáter molecules

470毫米

13,13 10^9 岁第一星系 years first galaxies

130毫米

13,00 10^9 年原银河系 years Primitive Milky Way

现在 Present Time

活动1：时间表 Activity 1: Timeline

13.80 10^9年原银河系

在84亿年（8.4米）的时间里，一系列同时发生的现象发生了。

第一批恒星的演化导致了不同的爆炸，驱逐了不同类型的原子，和多种元素周期表的出现，并且不同类型的物体同时出现。

- 蓝巨星和超巨星：过去10-1亿年（10-100毫米）。它们像超新星一样爆炸，喷出重原子，如铁、铅、金、铀等。
- 像太阳一样的黄色恒星：过去100亿年(10000毫米)。它们最终成为行星状星云，喷出中等重度的原子，如碳、氧、氮等。
- 红矮星：持续的时间比宇宙的年龄长。

8400毫米

4.60 10^9 年太阳的形成

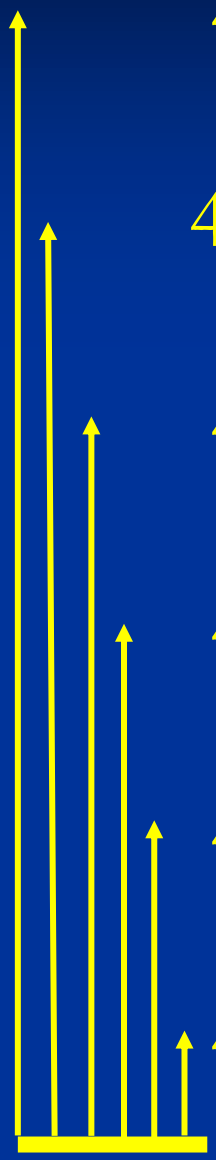
During the first 8.4 billion years (8.4 meters) a series of simultaneous phenomena took place.

The first stars evolved giving rise to different explosions that expelled different types of atoms and the diversity of elements of the periodic table appear. Different types of objects arise simultaneously:

- Blue giant and supergiant stars: last 10-100 million years (10-100mm). They explode as supernovae, ejecting heavy atoms such as Iron, Lead, Gold, Uranium, etc.
- Yellow stars like the Sun: last 10,000 million years (10 000 mm). They end up as planetary nebulae, ejecting medium-heavy atoms, such as Carbon, Oxygen, Nitrogen, etc.
- Red dwarf stars: Last longer than the age of the Universe.

4.6 x 10^9 years The Formation of the Sun

活动1：时间表 Activity 1: Timeline



4.600 10^9年太阳组 第1醇类 years sun formation

第一醇 1os Alcoholes

30毫米

4.570 10^9年太阳系的诞生 years Birth of the Solar System

4毫米

4.566 10^9岁巨行星 years Giant Planets

6毫米

4.560 10^9年地球和岩行星 years Earth and Rocky Planets

20毫米

4.540 10^9年地球磁场 years Earth's Magnetic Field

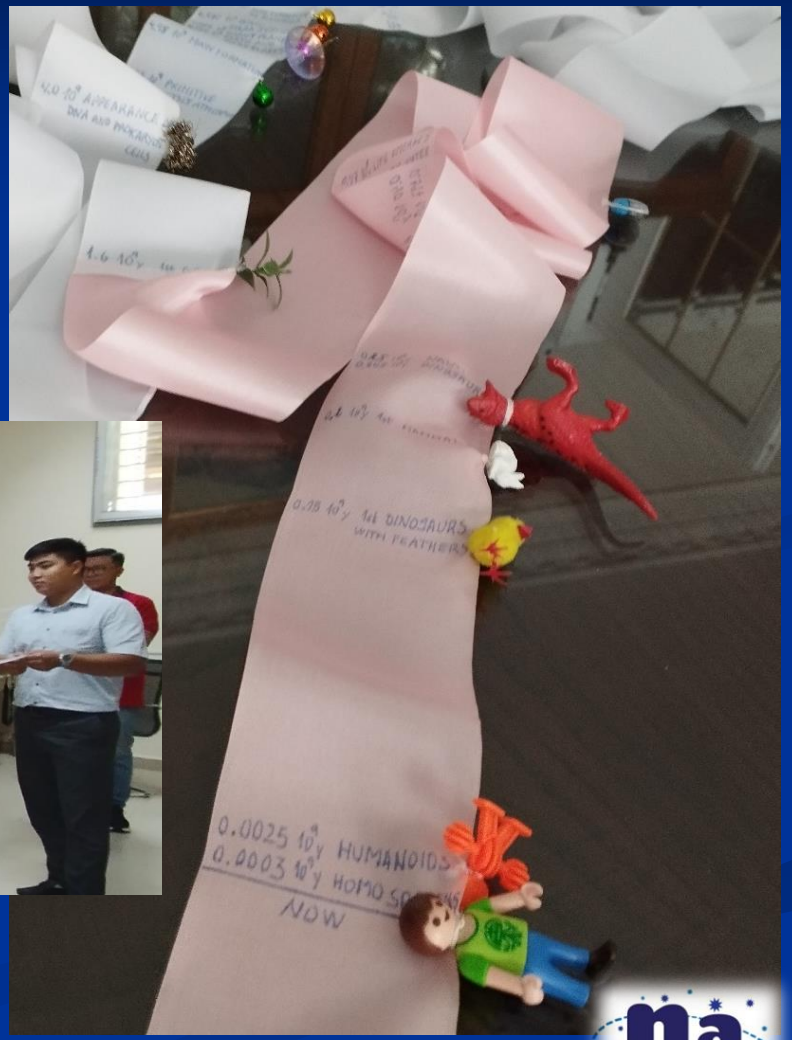
60毫米

4.480 10^9年月球形成 years Moon's Formation

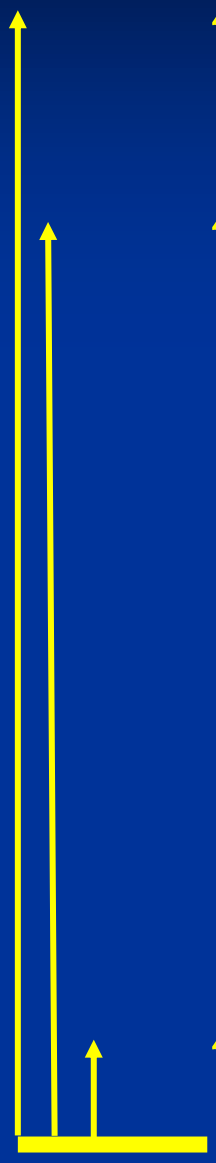
现在 Present Time

活动1：时间表

Activity 1 : Timeline



活动1：时间表 Activity 1: Timeline



4.48 10^9年月球形成 years Moon's Formation

30毫米

4.45 10^9年原始地球大气

years Primitive Earth's Atmosphere

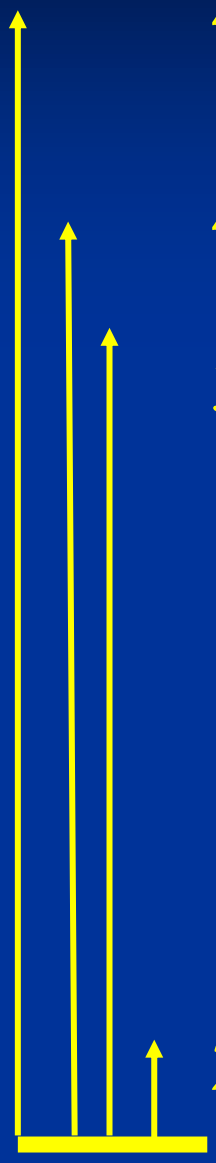
350毫米

4.10 10^9 年后的重炮轰击

现在 Now

years Late Heavy Bombardment

活动1：时间表 Activity 1: Timeline



4.10 10^9年后的重炮轰击 years Late Heavy Bombardment

100毫米

4.00 10^9岁DNA和原核细胞

years DNA and Prokaryotic Cells

300毫米

3.70 10^9年第一原海洋生物

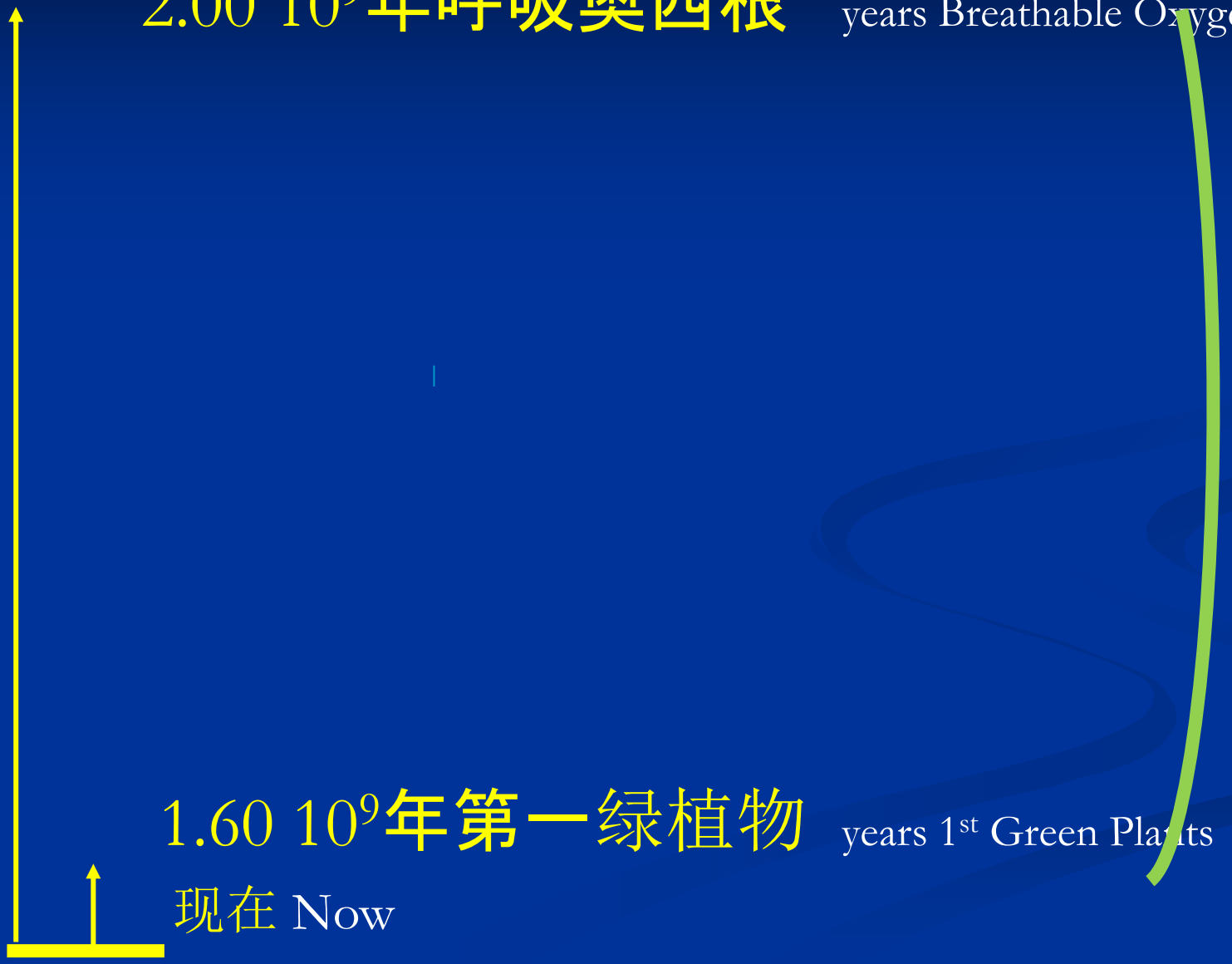
years 1st Primitive Marine Life

1700毫米

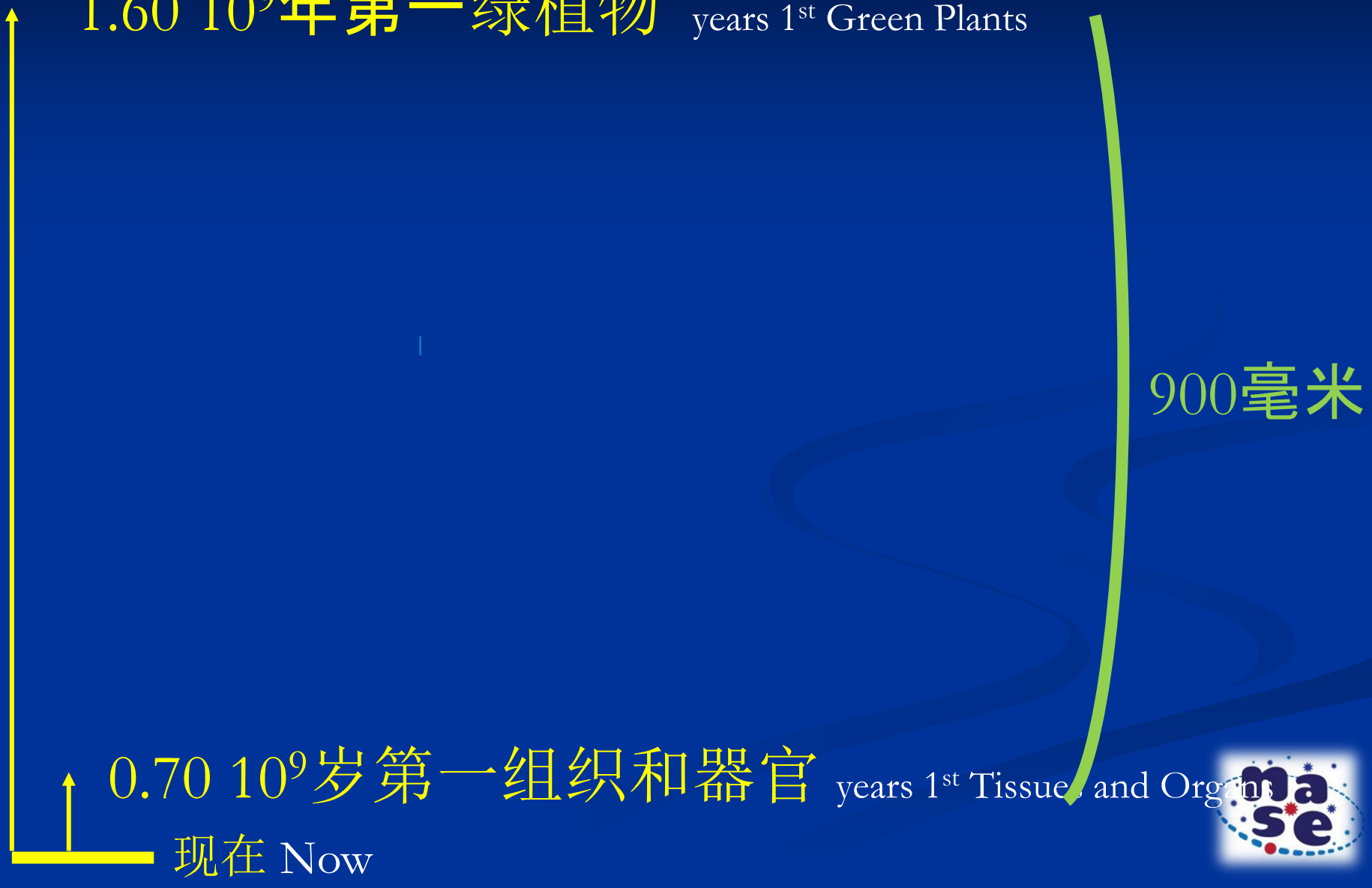
2.00 10^9年呼吸O_2 years Breathable O_2

现在 Now

活动1：时间表 Activity 1: Timeline



活动1：时间表


1.60 10^9年第一绿植物 years 1st Green Plants
900毫米
0.70 10^9岁第一组织和器官 years 1st Tissues and Organs
现在 Now

活动1：时间表 Actividad 1: Línea del Tiempo

0.700 10^9岁第一组织和器官 years 1st Tissues and Organs

150毫米

0.550 10^9年海洋生物 壳或骨架 years Marine organisms with shel

30毫米

0.520 10^9年三叶虫 years Trilobites

50毫米

0.470 10^9年第一生出自水中 years 1st Life emerges from the water

70毫米

0.400 10^9年氨石 years Ammonites

3毫米

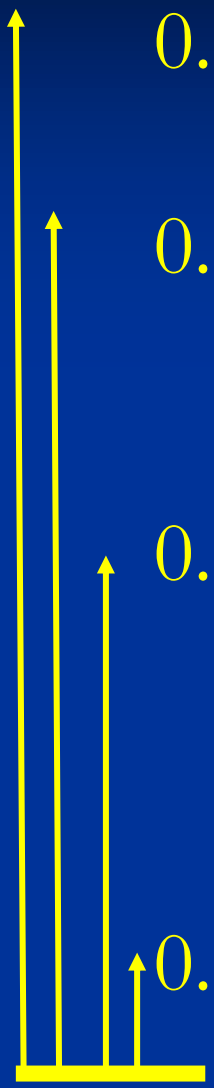
0.397地球上10^9岁第一脊椎动物 years 1st Vertebrates on Earth

0.250 10^9岁鹦鹉螺 years Nautilus

147毫米

现在 Now

活动1：时间表



0.250 10^9岁鹦鹉螺 years Nautilus

5毫米

0.245 10^9 年第一恐龙 years 1st Dinosaurs

45毫米

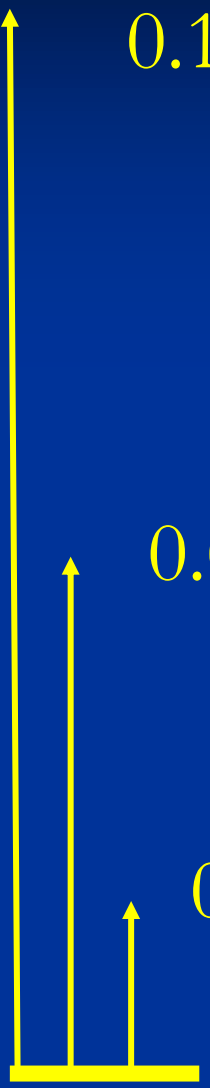
0.200 10^9 第一哺乳动物 years 1st Mammals

50毫米

0.150 10^9 第 1 只长有羽毛的恐龙

现在 Now years 1st Dinosaurs with feathers

活动1：时间表 Activity 1: Timeline



0.150 10^9 第 1 只长有羽毛的恐龙

years 1st Dinosaurs with feathers

147.5毫米

0.0025 10^9年 years = 2 500 000年 years

人鱼 Humanoids

2.2毫米

0.0003 10^9年 years = 30000 年 years

万年 智人 Homo Sapiens

0.3毫米

现在 Now

活动1：时间表

Activity 1: Timeline

食人星系

Cannibal Galaxies

星系是由引力束缚的星群，彼此旋转。

星系群形成宇宙的丝状结构。星系团在宇宙丝的交汇处形成。在这些星团中，年轻的星系竞争获得自由气体，而老的星系是赢家。星系的芭蕾，它们的相遇，它们的碰撞，以及大星系与小星系的互相吞噬促进了恒星的形成。

Galaxies are groups of stars bound by gravity, rotating about each other.

Groups of galaxies form the filaments of the universe. Galaxy clusters form at the junctions of cosmic filaments.
In these clusters the young galaxies compete to acquire the free gas and the older galaxies are the winners.
The ballet of galaxies, their encounters, their collisions and the cannibalism of the large ones over the small ones promotes star formation.

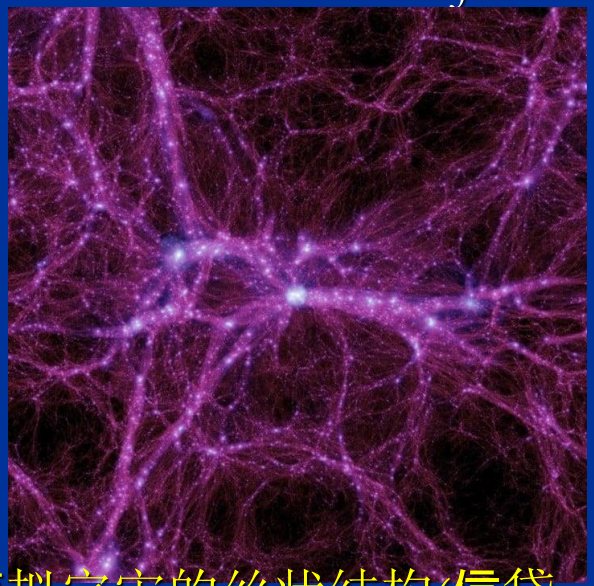
(来源ESO)

活动2：丝状模型

Activity 2: Filamentary Model

宇宙的丝状结构可以被认为是一个泡泡浴，物质聚集在泡泡上，特别是在它们的交叉处。只要有肥皂水和吸管或稻草。

The filamentary structure of the Universe can be thought of as a bubble bath where matter accumulates on top of the bubbles and especially at their intersections. Just use soapy water and a straw or straw.



模拟宇宙的丝状结构(信贷：Illustris项目)

Modelling the filamentary structure of the universe (Credit: Illustris Project)

用洗涤剂溶液模拟丝状结构

Modeling of the filamentary structure with a detergent solution

星系分类

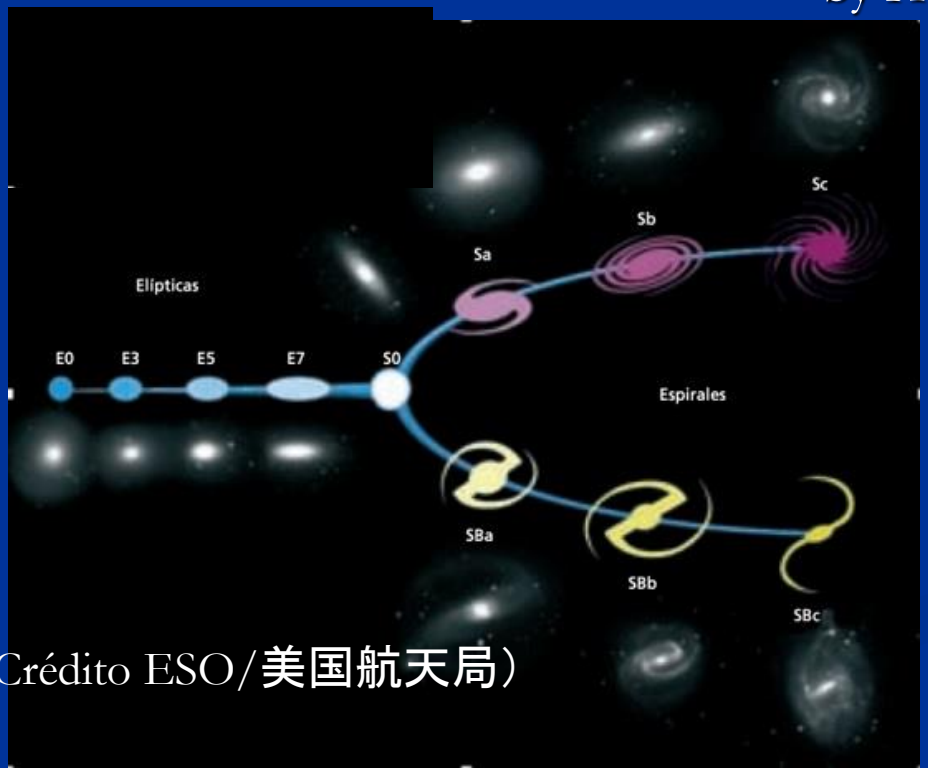
Galaxy Classification

这里有螺旋形，条状，椭圆形，不规则的……

它们通常根据它们的形态分类，在众所周知的**哈勃序列中**

There are spirals, barred, elliptical, irregular…

They are usually classified according to their morphology in the well-known sequence by Hubble



（Crédito ESO/美国航天局）

现在我们知道，这不是进化序列

It is now known that this is not an evolutionary sequence.

活动3：螺旋星系形成的模拟

Activity 3: Simulation of Spiral Galaxy Formation

可以用装满水的玻璃杯制作模型，然后用铅笔搅拌水。当你停止搅拌时，扔一汤匙的碳酸氢盐，细沙子或普通盐。在沉降之后，这些粒子会留下类似螺旋星系的形状。

A model can be made with a glass filled with water and stirring the water with a pencil. When you stop stirring, throw in a tablespoon of bicarbonate, fine sand or common salt. Upon settling, the grains are left in shapes similar to spiral galaxies.

从平面上看到的螺旋星系。（来源ESA/哈勃）

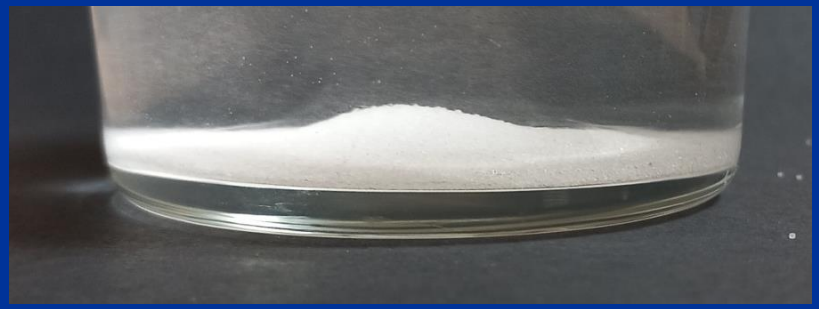
Spiral galaxy seen from above the plane. (Credit ESA/Hubble)

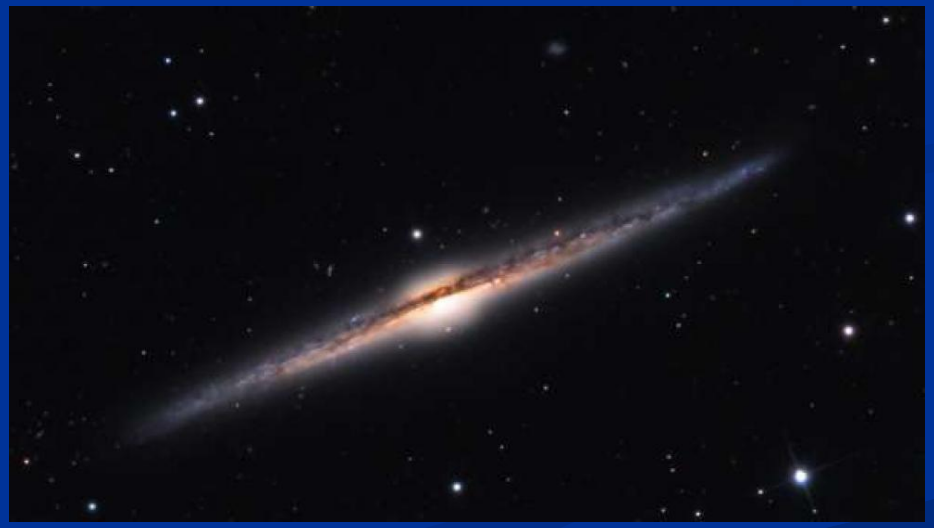
活动3：螺旋星系形成的模拟

Activity 3: Simulation of Spiral Galaxy Formation

从侧面观察模型，模拟星系中心的凸起。

Looking at the model from the side, the central bulge of galaxies is simulated.





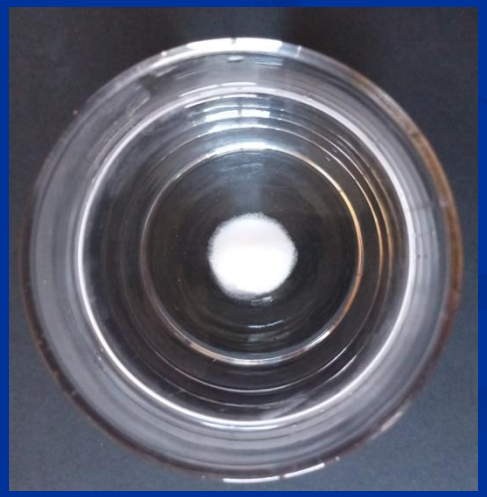
螺旋星系边对视图
（来源ESO/NASA）
Spiral galaxy edge-on view
(Credit ESO/NASA)

活动3：螺旋星系形成的模拟

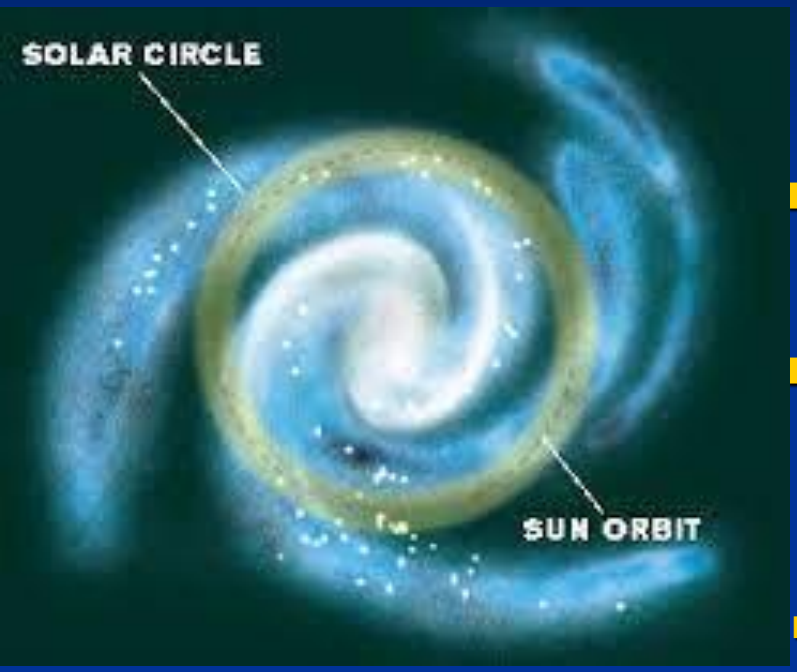
Activity 3: Simulation of Spiral Galaxy Formation

一旦星系形成，如果水继续被移除，就有可能得到类似球形的东西。

Once the galaxy is formed, if the water continues to be removed, it is possible to obtain a shape similar to elliptical galaxies.



星系中的适居带 Habitable Zone in Galaxies



- 在星系中，适居带通常位于距离星系中心23,000至30,000升.y.的半径(太阳是27,000升.y.)。
- 在这个区域外，边缘缺少重于H和He的原子，这些原子是生命所必需的。
- 在这个区域之外，靠近中心，有大量的伽马射线爆发，伴随着非常活跃和剧烈的事件，使生命变得不可能。

举例来说，为了比较时间线模型中的时间和距离，我们的星系需要220 10^6年（220毫米）旋转一圈。

By way of example, to compare time and distance in our model of the time line, our galaxy takes 220 x 10^6 years (220 mm) to make one revolution.

- The habitable zone in galaxies is normally located at a radius of between 23 000 to 30 000 l.y. from the centre of the galaxy (the Sun is at 27 000 l.y.).
- Outside this zone, toward the edge, the atoms heavier than H and He that are necessary for life are missing.
- Outside this zone, closer to the centre, there are massive gamma-ray bursts with very energetic and violent events that make life impossible.

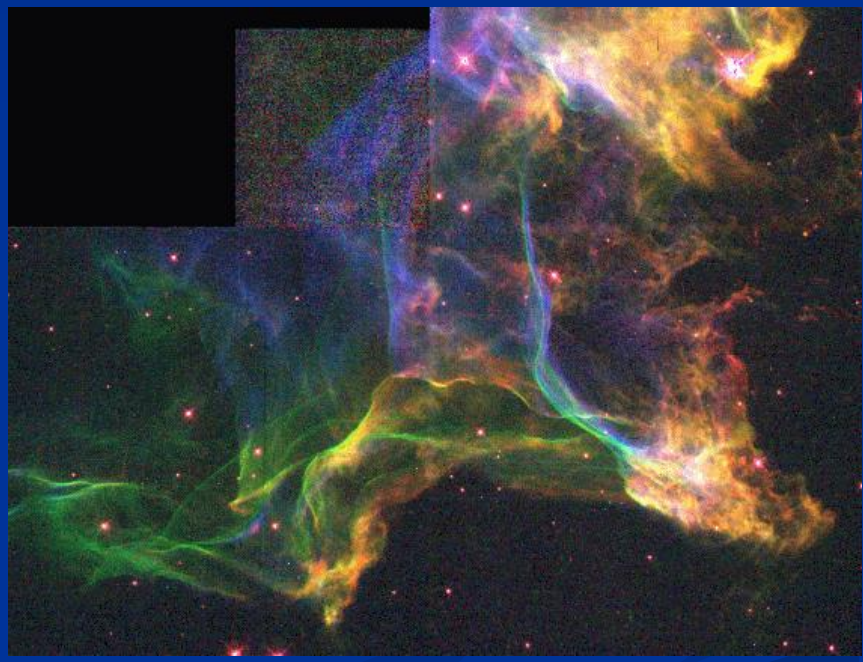
等离子体和磁场

Plasma and Magnetic Fields

- **在星系**间介质中，在星系间介质和恒星本身，物质**通常**处于等离子体状态。

- 这种等离子体由电子、质**子、高能粒子和**电离气体组成。

- In the intergalactic medium, in the interstellar medium and in the stars themselves, matter is usually in the plasma state.
- This plasma is made up of electrons, protons, high-energy particles and ionized gas.



细丝星云（来源：NASA）
Veil Nebula with filaments (Credit NASA)

等离子体和磁场

Plasma and Magnetic Fields

在地球上，有处于这种状态的物质，例如闪电、荧光灯或低消耗灯的内部、监视器和电视屏幕、等离子球或蜡烛的火焰

On Earth there is matter in this state in lightning, the interior of fluorescent tubes or low consumption lamps, monitors and television screens, plasma balls and the flame of a candle.

等离子体和磁场

Plasma and Magnetic Fields

太阳风也是等离子体，从太阳日冕释放出的带电粒子流。这些粒子的流动是变化的，可以产生地磁风暴，产生极光（南北的光）和变形彗星尾部的等离子体，这些彗星始终指向太阳。

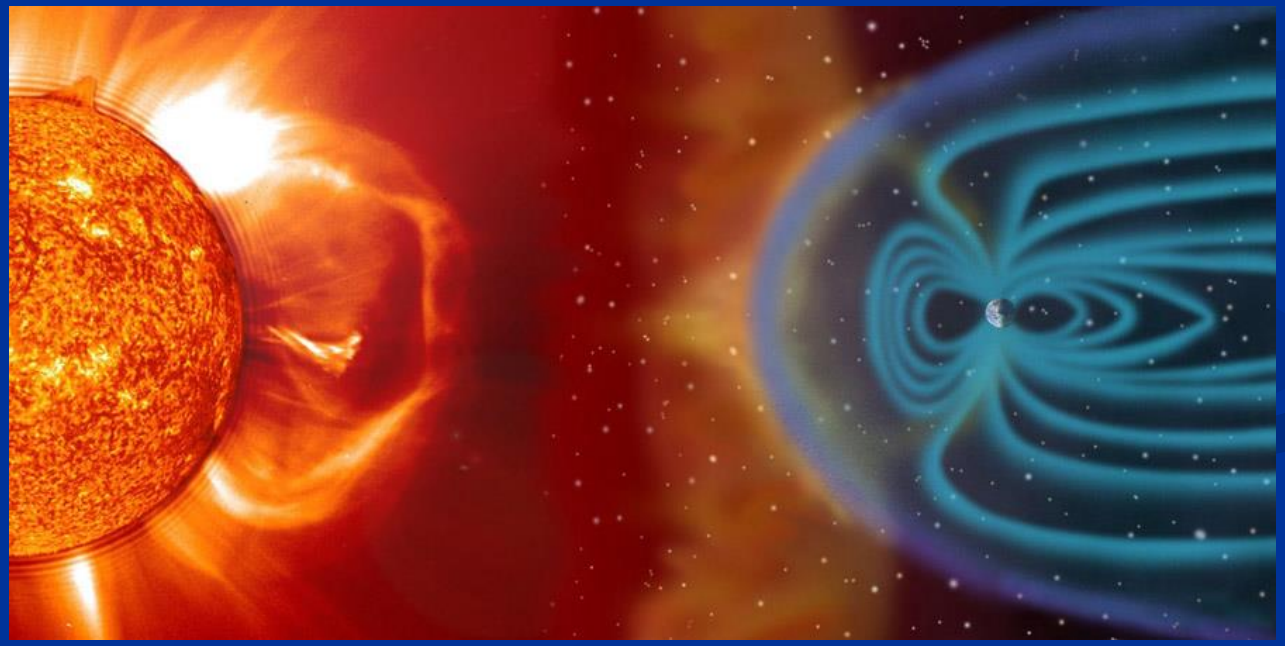
C/2002 E3
(来源雷基斯·巴比安斯卡斯和布雷
卡洛斯·维斯卡西利亚斯)

The solar wind is also plasma. It is a stream of charged particles released from the Sun's corona. The flow of these particles is variable and can generate geomagnetic storms, giving rise to auroras (The Northern and Southern Lights). It also deforms the plasma in the ion tails of comets.

等离子体和磁场 Plasma and Magnetic Fields

地球的磁场是地球上生命的保护屏障。高速行进的太阳风粒子携带大量的能量，具有很强的穿透力，能破坏细胞的DNA。

The Earth's magnetic field acts as a protective shield for life on the planet. Solar wind particles that travel at high speed and with a lot of energy have great penetrating power and would damage the DNA of cells.



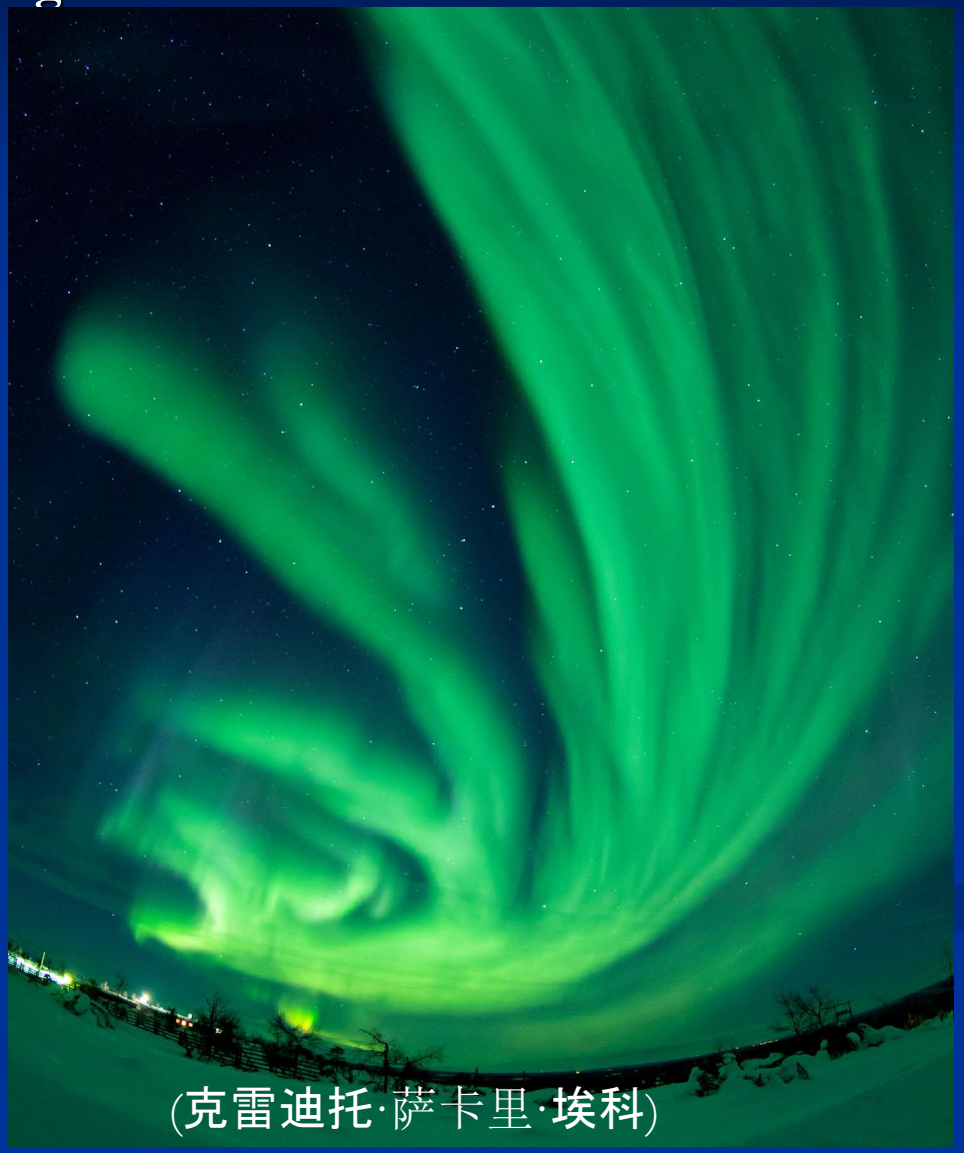
太阳风，
艺术家印象
(**来源**NASA)
Sun wind,
artist impression.
(Credit NASA)

等离子体和磁场

Plasma and Magnetic Fields

地球的磁场就像雨伞，转移对生命如此危险的带电粒子到达地球表面；**它**们与大气层的相互**作用**产生各种颜色的美丽极光。

The Earth's magnetic field acts like an umbrella, diverting charged particles that are dangerous to life, from reaching the Earth's surface. Their interaction with the atmosphere generates the beautiful auroras of various colours.



(克雷迪托·萨卡里·埃科)

等离子体和磁场 Plasma and Magnetic Fields

极光的颜色取决于与它们相互作用的空气中的分子的能量。在以下区域内：

在非常高的能级，氧是绿色/黄色，而在低能级，它是红色/紫。
氮，如果失去最外层的电子，会产生蓝色的光，而在极光的下边缘会呈现红色/紫色。

The colours of the auroras depend on the energy of the molecules in the air with which they interact. In an area of:

Oxygen at very high energy levels emits green/yellow light and at low levels red/purple.
Nitrogen, if it loses electrons in its outermost layer, produces a bluish light, while it gives a red/purple colour at the lower edges of auroras.

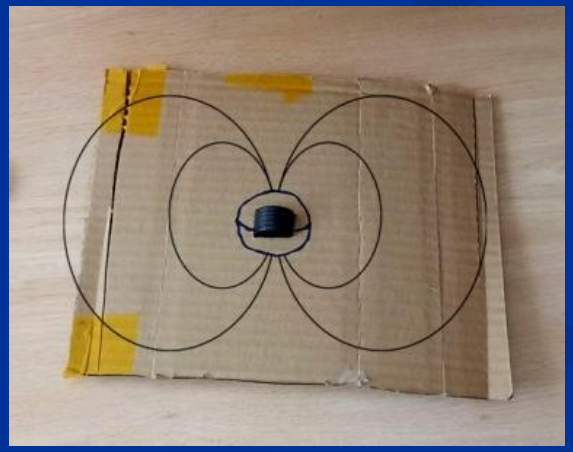
(来源萨卡里·埃科)

活动4：地球的磁场

Activity 4: Earth's Magnetic Field

我们可以用一块代表地球的磁铁和一个罗盘来想象地球磁场，用它来穿越磁场的力线。

We can visualize the terrestrial magnetic field with a magnet, which represents the Earth, and a compass, with which we go through the lines of force of the field.



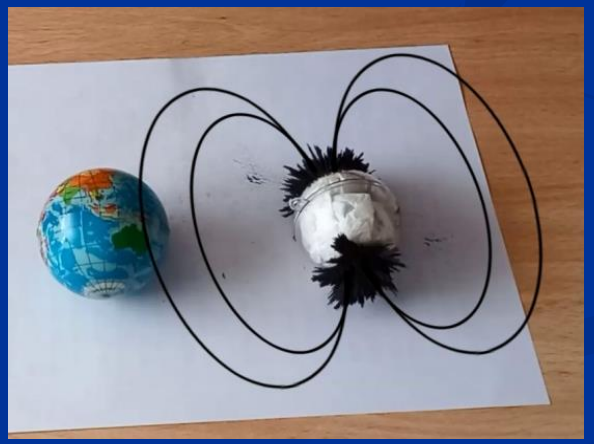
活动4：地球的磁场

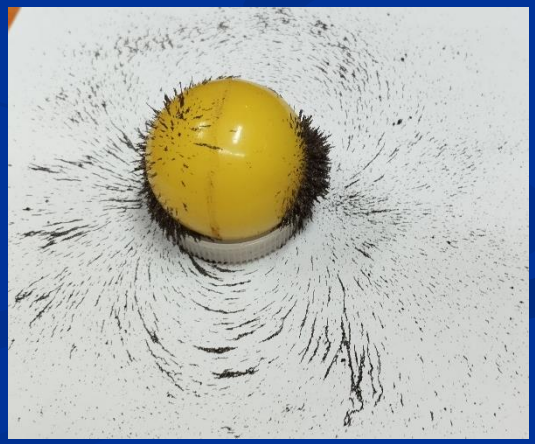
Activity 4: Earth's Magnetic Field

在一个塑料球里，我们放了一块用纸巾包裹的磁铁。它代表地球。

在两极附近放上铁屑，该地区的磁场线，即极光发生的地方，就非常直观了。

In a plastic sphere, we put a magnet wrapped in a paper napkin. It represents the Earth. With iron filings near the poles, the magnetic field lines in that area, where the auroras occur, are very well visualized.





生命是如何在地球上出现的？

How did life arise on Earth?

最广为接受的假设是生命起源于106年前4500年的无机物

但其他科学家认为生命起源于地外。如果生命不是在地球上开始的，它可能会到达彗星、小行星和陨石。

微生物可以埋藏在岩石中生存，免受外层空间的极端条件的影响

The most accepted hypotheses assume that life arose on Earth from inorganic matter 4 500 x 10^6 years ago.

But other scientists assume an extraterrestrial origin of life. If life did not start on Earth, it could have arrived on comets, asteroids or meteorites.

Microbes could survive embedded in rocks, protected from t
extreme conditions of outer space.

没有人认为第一个活着的人非常复杂。肯定有更简单的生命形式，在第一个有机体和今天的生命之间充当了联系。极嗜微生物可能到达地球上的小行星和陨石撞击其表面；事实上，一些陨石中发现了有机样品。找到陨石并不容易，但是寻找微陨石却很容易。

No one supposes that the first living being was very complex. There must have been simpler forms of life that have served as a connection between the first organism and life today. It is possible that extremophile microorganisms reached Earth on asteroids or meteorites that impacted on its surface. In fact organic samples are found in some meteorites. It is not easy to find meteorites, but it is easy to **hunt micrometeorites**.

我们还将看到地球上有极端嗜血杆菌发现的某些地区，美国国家航空航天局和欧洲航天局正在对这些地区进行研究

We will also see some areas of the Earth where extremophiles are found and which are studied by NASA and ESA.

微陨石

Micrometeorites

地球绕行太阳，通过其它恒星的轨道，例如带有尘埃痕迹的彗星。这些小天体落在地球表面，并形成小陨石。每天有成千上万的流星坠落，通常在到达地面前会燃烧（由于与大气层的摩擦），形成流星。

那些到达地面的可以收集，它们可以在任何地方，特别是在人类活动少且难以进入的地方。它的圆形和凹槽暴露了它的起源。

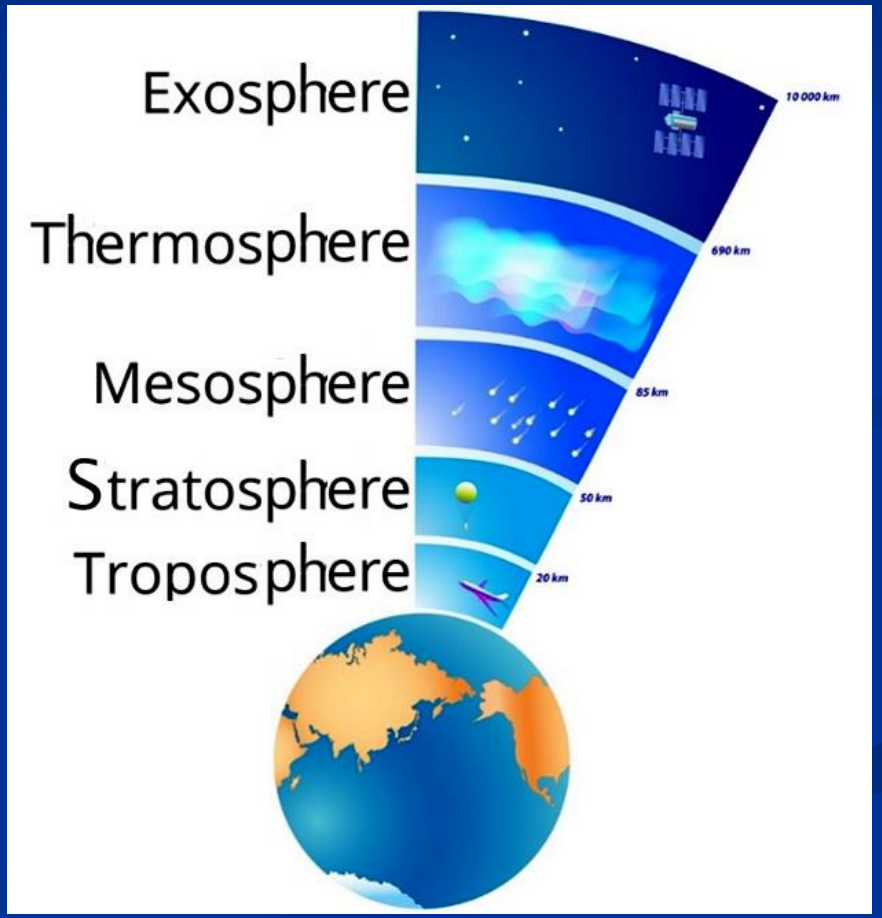
The Earth goes through the orbits of comets where it encounters traces of dust. This dust falls on the Earth's surface and gives rise to micrometeorites. Thousands of them fall every day and they normally burn up (due to friction with the atmosphere) before reaching the ground, forming shooting stars.

Those that reach the ground can be collected. They are everywhere. They are easier to find in places with little human activity or places that are difficult to access. Their rounded shapes and grooves betray their origin.

微陨石

Micrometeorites

流星通过外大气层和热大气层时没有什么麻烦，因为这些层的密度不大。但是当它们到达中间层时，密度更高，空气将引起更多的摩擦并产生热量。材料熔化，然后凝固，所以最后呈现出凹槽，有时还有小气泡，这是快速凝固的效果。



Meteors pass through the exosphere and thermosphere without much trouble because these layers are not very dense. But when they reach the mesosphere, the density is higher and the air will cause more friction and create heat. The material melts and then solidifies so that in the end it presents grooves and sometimes small bubbles, the effect of rapid solidification.

活动5：模拟可食性微陨石

Activity 5: Simulation of Spherical Micrometeorites

将流星体转化为小球体的过程最合适的经验是在厨房用琼脂或鸡足明胶进行的球化。

Fill a tall glass with sunflower oil. Drops of water or cola are dropped from a syringe. Small spheres are formed and can be seen slowly falling down the oil column.

中层液滴

滴下静止的液体，在粘性介质内变成球形

平流层和对流层

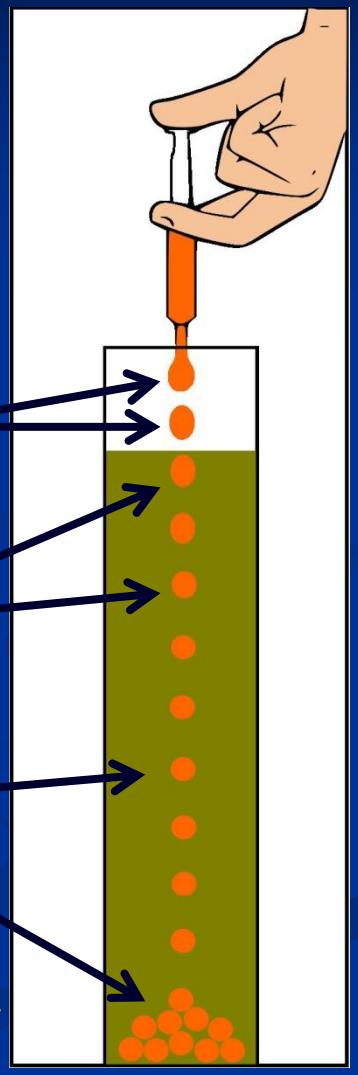
球状液滴在底部凝固聚集

MESOSPHERE Liquid drops.

Drops still liquid, become spherical within the viscous medium.

STRATOSPHERE AND TROPOSPHERE

Spherical drops solidify and accumulate at the bottom.



大陆地壳和海洋的 Continental Crust and oceanic floor

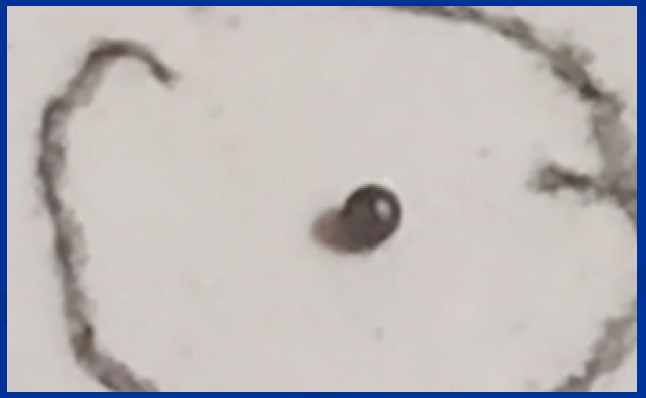
活动5：模拟球形微陨石

Activity 5: Simulation of Spherical Micrometeorites

形成模拟 "微陨石 "的小球体。

small spheres of simulated "micro-meteorites" are formed.

真正的微陨石
real micrometeorite



每天它们都会落在地球表面 5吨的外星物质!

Every day they fall on the Earth's surface 5 tons of alien material!

活动6：寻找微陨石

Activity 6: Look for Micrometeorites

微陨石沉积在屋顶和露台上，甚至长时间悬浮在大气中，并随雨雪一起坠落。回收这些材料最推荐的方法是在收集沉积在屋顶上的材料的排水沟中寻找它，或者在街道或高速公路的排水沟中寻找它。

Micrometeorites are deposited on roofs and terraces or even remain suspended in the atmosphere for a long time and then fall together with rain or snow. The best method for the recovery of this material is to look for it in gutters, which collect the material that has been deposited on the roofs or in the gutters of the streets or highways.

这些陨石直接来自形成太阳系的物质。因此，它们大约45亿岁。

These meteorites come directly from the matter that gave rise to the Solar System. They are therefore about
4 500 million years old.

活动6：寻找微陨石

Activity 6: Look for Micrometeorites

这些陨石大多是岩石组成，但其他都是铁和镍的陨石，可以用磁铁与其他的陨石分离。

Most of these meteorites have a rocky composition, but others are made of iron and nickel and can be separated from the rest with a magnet.

用刷子从沟渠或沟渠中收集沙子，然后将其放在纸上。一块磁铁穿过纸下面，我们只用移动的材料留在纸上

With a brush, sand is collected from a gutter or a ditch, and it is placed on a piece of paper. Pass a magnet under the paper to see which particles move.

活动6：寻找微陨石

Activity 6: Look for Micrometeorites

如果你没有可以寻找陨石的露台或沟渠，你可以准备一个陷阱来收集微陨石。一个纸盘就足够了，我们可以把玻璃纸放在那里，放在稍微高一点的地方，让纸从外面丢一个星期，这样动物们就不会靠近了。收集微陨石的过程也是使用磁铁

If you don't have terraces or ditches where you can look for micrometeorites, you can prepare a trap to collect them. Place cellophane paper in a tray and leave it out in the open for a week in a slightly elevated place so that animals do not approach. The process of collecting the micrometeorites is also done with a magnet.

活动6：寻找微陨石

Activity 6: Look for Micrometeorites

另一种可能性是为每个学生准备一个陷阱，让一个纸杯系上绳子，杯子里装一块小磁铁。学生带着磁铁杯在学校周围移动，当移除磁铁时，如果有铁颗粒，他们会落在白纸上。只要通过手机上的摄像头就能找到陨石。

Another possibility is to prepare a trap for each student with a paper cup tied with a string and a small magnet inside the cup. Students move around the schoolyard area with the magnet cups and, when removing the magnet, if there are iron particles, they will fall on the white sheet of paper. Just look through the cameras of their mobile phones to find the micrometeorites.

活动6: 寻找微陨石

Activity 6: Look for Micrometeorites

微陨石的鉴定：

在没有从纸上移除的情况下，随着磁铁移动的材料，我们用手机或移动相机进行检查，使用最大变焦量。

微陨石的形状接近球形且明亮。

Identification of micrometeorites:

Inspect the material that has moved with the magnet, without removing it from the paper, with a cell phone or camera, using the maximum zoom.

Micrometeorites are identified by having a nearly spherical and bright shape.

嗜极体分类

Extremophile Classification

极端嗜血杆菌是一种生活在极端条件下（那些与大多数陆地生命体所经历的极端不同）的生物体（通常是微生物）。

直到最近，人们还认为极端嗜血杆菌在哪里生长是不可能生存的。例如，在力拓高酸度和含金属的水域，或在极度干燥和含重金属的阿塔卡马沙漠。

但是已经证明有生物生活在这些地区。

An extremophile is an organism (often a microorganism) that lives in extreme conditions (conditions that are very different from those experienced by most terrestrial life forms).

Until recently, it was thought that it was impossible for life to exist where extremophiles grow. For example, in the highly acidic and metal-containing waters of the river Rio Tinto in Spain, or in the extremely dry and heavy-metal-containing Atacama desert o en la Antártida con sus bajas temperaturas.

But it has been shown that there are organisms that live in these areas.

南极洲的嗜极生物

Extremophiles in Antarctica

例如，在南极洲，几个科学家小组已经在其表面以下发现了生命:

In Antarctica, several groups of scientists have found life below its surface, for example:

- 生活在36米深、温度为-20°C的盐水中的极端亲水微生物（由于盐的浓度很高，所以没有结冰）
- 一个在800米深处完全无光的生态系统
- extremophile microbes living at 36 m with temperatures of -20°C in salt water (not frozen due to the high concentration of salt)
- an ecosystem in total absence of light at 800 m depth

极端嗜血者与阿塔卡马沙漠

Extremophiles and Atacama Desert

一些极端嗜血杆菌在没有水的情况下生活，或仅靠很少量就能够耐受干燥。就像阿塔卡马沙漠土壤中的微生物。

Some extremophiles live in the near absence of water or are able to withstand desiccation by living with very little. Like the microbes in the soil of the Atacama Desert.

这里有一个非常壮观的现象：开花的沙漠。这是世界上最干旱的沙漠，当降雨量超过正常水平，然后冷锋出现大量和多样的花（14种），并持续数月。

There is a very spectacular phenomenon: the flowery desert. This is the most arid desert in the world. In years when there is more precipitation than normal and a cold front appears, a large number and diversity of flowers (14 varieties) last for a few months.

Photo August 2022 after several years of dryness, the last years were 2015 and 2017.

照片摄于2022年8月，经过数年的干燥，最后几年是2015年和2017年

嗜极菌和里奥廷托

Extremophiles and the Rio Tinto

其他极端微生物在高酸度和高金属浓度（铁，铜，镉，砷，锌，铅）的环境中繁殖。这条河里的反应由嗜酸细菌催化，所以如果酸度降低，细菌种群会倍增，产生更多的硫化物氧化，在回馈的过程中产生更多的酸度。由于河流颜色的变化(细菌产生更多的酸度以维持河水泛滥时的ph值)，该地区居民知道何时会下雨。

Other extremophiles thrive in environments with high acidity and high metal concentrations (Iron, Copper, Cadmium, Arsenic, Zinc and Lead). The reactions in this river are catalysed by acidophilic bacteria, so that if the acidity is reduced, the bacteria population multiplies. This generates more oxidation of sulphides and more acidity in a process that feeds back. The inhabitants of the area know when it is going to rain because of the colour changes of the river (bacteria generate more acidity to maintain the pH during the flooding of the river).

极端嗜血者与植被力拓

Extremophiles & Vegetation - Rio Tinto

沿河床分布着大量的Erica Andevalensis或“采矿希瑟”的灌木。

There are extensive groups of the shrub Erica Andevalensis or “mining heather” distributed along the riverbed.

这些植物的根部位于高酸度的土壤中，几乎没有营养物质。一些植物甚至生长在河岸，它们的根部分浸没在酸性水和高浓度铜和铅的土壤中。

These plants have their roots in highly acidic soils with few nutrients. Some plants even grow on the banks of the river with their roots partially submerged in acidic water and soils with high concentrations of Copper and Lead.

活性7：DNA提取

Activity 7: Extraction of DNA

NASA 和ESA的天体生物学家在地面(Ríotinto Mines，　Atacama Desert等)研究生命如何演化或适应来理解生命的起。

许多发现极端嗜血杆菌的协议的第一步包括DNA提取过程，因此进行该活动

NASA and ESA astrobiologists study on the ground (Rio Tinto Mines, Atacama Desert etc.) to understand how life evolves or adapts and how it originated.

The first step of many of the processes that are carried out to discover extremophiles consists of DNA extraction.

活性7: DNA 提取

Activity 7: DNA extraction

序列DNA允许检测生命的存在（当前或过去），这用于搜索空间中的生命。

这种DNA**分子非常**长，细胞内有大量蛋白质（像一个羊毛球）。

破壁溶液：1/2**杯水**

1茶匙盐氯化钠可以去除蛋白质从而释放DNA

3茶匙碳酸氢钠，以保持溶液的pH**基本和恒定，并保持**DNA**的未降解**

加入洗碗液直到溶液颜色相同，使油脂细胞的膜破碎

不加发泡剂的**混合可以很好地**观察到DNA。

The sequence DNA allows the detection of the existence of life (current or past) and this is used to search for life in space.

The DNA molecule is very long and packed with proteins (like a ball of wool) inside cells.

Solution to break the cell: Take half a glass of water,

1 teaspoon of Salt (Sodium Chloride) to remove the proteins and thus release the DNA.

3 teaspoons of Sodium Bicarbonate, to keep the pH of the solution basic and constant so that the DNA remains undegraded.

Add dishwashing liquid until the solution has the same colour, to break the membrane of the greasy cells

Mix without foaming to get a good view of the DNA.

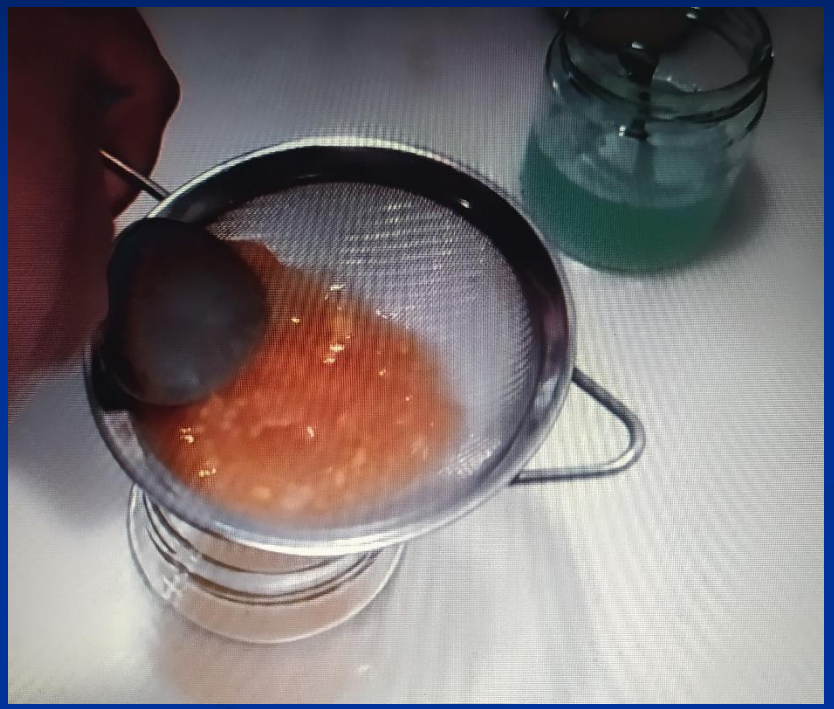
活性7：DNA提取

Activity 7: DNA extraction

准备细胞汁 “西红柿”

2汤匙西红柿酱，用叉子捣碎，直到变纯

我们加入了创新性的解决方案(**解决方案的体**积是西红柿酱的**两倍**)。



Prepare the cell juice "of tomato"

2 tablespoons tomato pulp, mash it with a fork until becomes pureed

We add the innovative solution (the volume of the solution is double compared to that of the tomato puree).

我们小心地混合以破坏细胞，小心不要发泡。**然后我们用力去掉大块**

细胞内的内容物在汁液中

We mix carefully to break the cells, being careful not to foam. Then we strain to remove the large pieces. **The content inside the cells is in the juice**

活性7：DNA提取

Activity 7: DNA extraction

使DNA可见

当有很多DNA链时，我们把它看作白云（盐让它呈白色，DNA肉眼看不见）。我们慢慢地加入酒精，把它滴在果汁的壁上，因为我们想要醇层保持在果汁的上面，不要将它们混合。在3或4分钟内，DNA形成的白色云团聚集并变得可见（爬到顶端）。加入酒精是因为DNA不溶于酒精，从而形成DNA云。

Make DNA visible

When there are many strands of DNA we see it as a white cloud (salt gives it a whitish color, DNA is not visible to the naked eye). We slowly add alcohol, dripping it on the wall of the glass of juice, because we want the layer of alcohol to remain above the juice without mix them. In 3 or 4 minutes a white cloud of DNA forms which agglomerates and becomes visible (climbing to the top). Alcohol is added because the DNA is not soluble in alcohol and thus a cloud of DNA is formed.

结论

Conclusions

- 了解生命出现的漫长过程
- 了解环境可以保护生命。
- 了解生命可能发展的极端环境。
- 了解DNA提取过程以验证生命的存在。

- Understanding the long process for the appearance of life
- Knowing the conditions protects life.
- Know the extreme environments in which life can develop.
- Understand the DNA extraction process to verify the presence of life.

非常感谢您的关注!

Thank you very much for your attention!