

Study Guide: Deep-Time6(1).pptx

[!NOTE] Extracted content from presentation. Images are embedded below.

Slide 1

Original Content

- Life Over Deep Time Session 6
- Cephalopods
 - Modern diversity and classification
 - Fossil preservation
 - Nautiloids coiled and straight- Ammonoid growth forms
 - Ammonite shell form and biology, belemnites
- Echinoderms
 - Classification
 - Biology
 - Echinoderms (urchins)
- Practical:
 - Target: be able to identify, sketch and label the characteristic morphological characters of a cephalopod.
 - Access primary literature to understand why the theoretical value of Copes Law and the data that supports it.
 - Create and evaluate hypotheses that account for the accumulation of ammonites in the bed described



讲师讲解：

本节课重点介绍两类海洋无脊椎动物：头足纲 (Cephalopods) 和 棘皮动物门 (Echinoderms)。

- **头足类**：我们将探讨其多样性、化石保存、以及 鹦鹉螺 (Nautiloids) 和 菊石 (Ammonoids) 的形态。
 - **棘皮动物**：重点简述其分类和生物学，特别是海胆。
 - **实践目标**：需要掌握头足类形态绘图，并理解 柯普定律 (Cope's Law)（生物体型随演化增大的理论）。
-

Slide 2

Original Content

- Learning Outcomes
- Understand the basic biology of cephalopods and echinoderms.
- Apply your understanding to stratigraphic problems
- Dating rocks in the field using cephalopod sutures
- Hypotheses testing
- Harvesting data and concepts from the literature

讲师讲解

讲师讲解：

本页列出了核心学习目标：

- 掌握两类动物的基础生物学。
 - 地层学应用 (Stratigraphic problems)：这是关键，特别是利用头足类的 缝合线 (Sutures) 来进行 岩石定年 (Dating rocks)。
 - 培养科学思维，包括假设检验和文献阅读能力。
-

Slide 3

Original Content

- Segments
- Segment 1: Biology and classification of modern cephalopods
- Segment 2: Fossil cephalopods
- Segment 3: Echinoderms

🎓 讲师讲解

讲师讲解：

课程分为三段：

1. 现代头足类 (Modern cephalopods): 生物学与分类。
 2. 化石头足类 (Fossil cephalopods): 如菊石和箭石。
 3. 棘皮动物 (Echinoderms)。
-

Slide 4

Original Content

- Segment 1: Intro to Cephalopoda
- Class Cephalopoda
- Subclass Nautiloidea
- Subclass Ammonoidea: (400.0—65.0 Ma)
 - Order Goniatitida (388.5- 252.0 Ma)
 - Order Ceratitida (254.0-200.0 Ma)
 - Order Ammonitida (215.0-66.0 Ma)
- Subclass Coleoidea (410.0 Ma-Rec)
 - ??Cohort Belemnoidea: Belemnites and kin
- Superorder Decapodiformes (Squid and Octopods). Won't discuss much but they do have fossils

讲师讲解

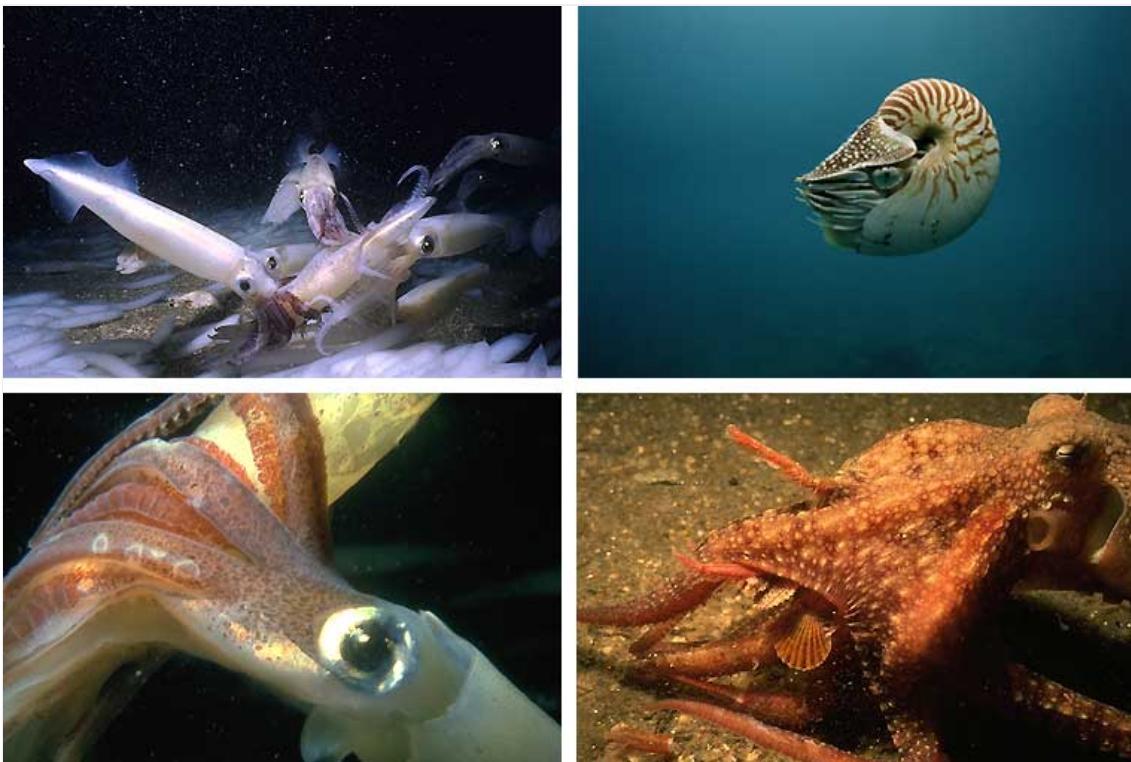
讲师讲解：

这是 头足纲 (**Cephalopoda**) 的分类框架：

- 鹦鹉螺亚纲 (**Nautiloidea**)：基干类群。
 - 菊石亚纲 (**Ammonoidea**)：已灭绝。注意三个目的演化顺序：**棱菊石 (Goniatitida)** -> **齿菊石 (Ceratitida)** -> **真菊石 (Ammonitida)**。
 - 鞘亚纲 (**Coleoidea**)：包括 **箭石 (Belemnites)** 和现代的十腕总目（鱿鱼、章鱼）。
-

Slide 5

Visuals



Original Content

- Phylum Mollusca: Class Cephalopoda

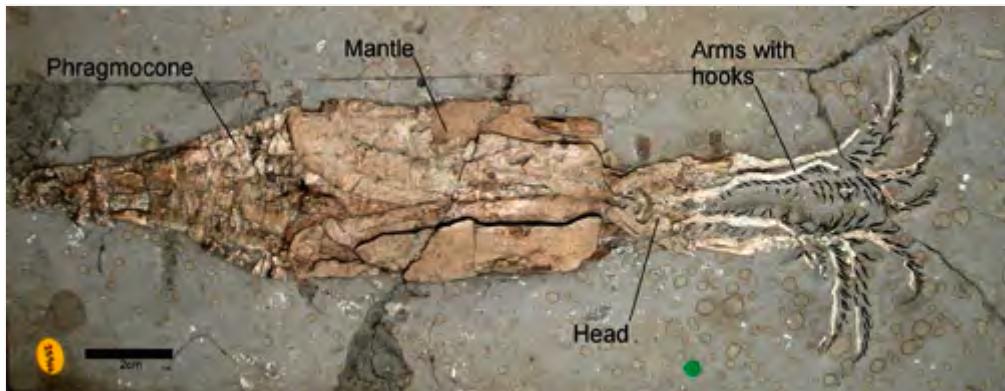
🎓 讲师讲解

讲师讲解：

这是一张典型的现代头足类解剖图。注意观察其 **触手 (Tentacles)** 和头部结构，这是“头足纲”名称的来源。

Slide 6

Visuals



Original Content

- Exceptionally Preserved Squid (Jurassic Oxford Clay of Wiltshire)

🎓 讲师讲解

讲师讲解：

这是 **特异埋藏 (Exceptionally Preserved)** 的化石案例。发现于英国 Wiltshire 的 Jurassic Oxford Clay。这就保存了乌贼的软组织，让我们能研究其精细结构。

Slide 7

Visuals



Original Content

- Exceptionally preserved Octopods

讲师讲解

讲师讲解：

这里展示了保存完好的 八腕目 (*Octopus*) 化石。通常软体动物很难形成化石，但在缺氧环境下的特异埋藏可以保留下。

Slide 8

Visuals



Original Content

- Modern Cephalopoda

🎓 讲师讲解

讲师讲解：

这是现代头足类的照片，作为 现代参照物 (Modern Analogue)，帮助我们推测古代化石生物的生活习性。

Slide 9

Original Content

- Cephalopoda: how advanced?
- Collaborative hunting techniques
- Capable of complex and dexterous movement
- Can communicate via colour change of skin
- Complex optics suggests that their brain has some degree of processing power.

讲师讲解

讲师讲解：

头足类非常 高等 (**Advanced**)：

- 协作捕猎 (**Collaborative hunting**)。
 - 复杂运动 (**Complex movement**)。
 - 变色交流 (**Communication via colour change**)。
 - 复杂视觉 (**Complex optics**)：表明它们大脑有相当的处理能力。
-

Slide 10

Original Content

- Cephalopoda: how advanced?
- Tool use!
- http://www.youtube.com/watch?v=AP_dpbTbess
- Finn, JK, Tregenza, T, and Norman, MD, 2009. Defensive tool use in a coconut-carrying octopus *Current Biology*, Volume 19, Issue 23, 1069-1070
- <http://download.cell.com/current-biology/pdf/PIIS0960982209019149.pdf?intermediate=true>

🎓 讲师讲解

讲师讲解：

这一页展示了惊人的 **工具使用 (Tool use)** 能力。提到的研究 (Finn et al., 2009) 记录了章鱼携带椰子壳作为防御工具。

Slide 11

Original Content

- Cephalopoda: In the blood
- Blood composed of hemocyanin, copper based organic molecule. This is dissolved in the blood and not carried in acell.
- Deoxygenated form is clear, oxygenated form is blue.
- Cephalopod blood greater oxygen carrying capacity than other molluscs.
- Modern cephalopods capable of depleting oxygen reserve in venous blood. Does this imply a limit to the evolution of the cephalopod brain?

讲师讲解

讲师讲解：

讨论生理限制。

- **血蓝蛋白 (Hemocyanin)**: 铜基血液，氧合时呈蓝色。直接溶解在血浆中。
 - **演化瓶颈**: 尽管比其他软体动物携氧强，但现代头足类在运动中容易耗尽静脉血氧。这可能限制了它们大脑进一步演化的能量上限。
-

Slide 12

Visuals



Original Content

- Modern Nautilus

🎓 讲师讲解

讲师讲解：

这是 现代鹦鹉螺 (Modern Nautilus) 的照片。它是我们研究菊石最重要的“活化石”。

Slide 13

Original Content

- Nautiloid: mode of life
- Modern Nautilus is coiled and nektonic.
- Shell is made of aragonite.
- Can swim at up to 50cm/sec using a jet.
- Can position the jet to swim backwards or forwards.



讲师讲解：

生活模式 (Mode of Life):

- 游泳 (Nektonic): 利用喷水推进，速度可达 50cm/s。
 - 文石壳 (Aragonite Shell): 材质是文石。
 - 机动性：可以调节喷口方向，实现前后游动。
-

Slide 14

Original Content

- Segment 2
- Fossil Cephalopods



讲师讲解：

进入第二部分：化石头足类。

Slide 15

Visuals



Original Content

- Fossil Orthocerids adopted a range of shell shapes
- Cameroceras is reported to have achieved lengths of 10m!!!!!!
- This makes it the biggest predator of its day (Ordovician to Silurian).
- Note the genus name is something of a wastebasket term.

讲师讲解

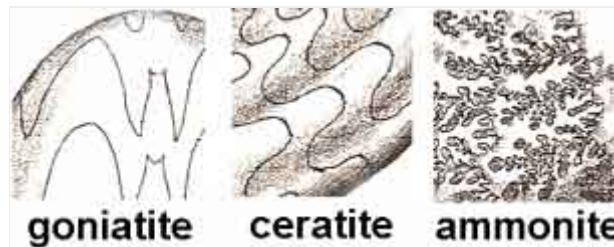
讲师讲解：

直壳鹦鹉螺 (Orthocones)：

- 早期采取了各种壳形。
 - 房角石 (Cameroceras)：据说长达10米！是奥陶纪-志留纪的顶级掠食者。
-

Slide 16

Visuals



Original Content

- Subclass Ammonoidea: (400—65.0 MA)
- Sutures
- Orders
- Goniatite Ceratite Ammonite

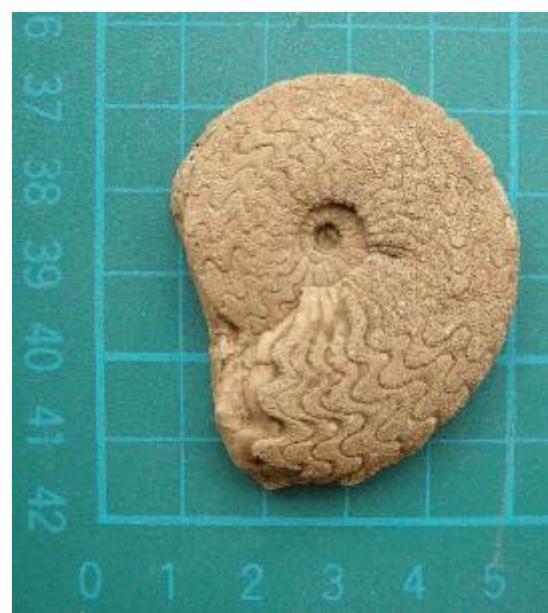
🎓 讲师讲解

讲师讲解：

菊石亚纲 (Ammonoidea) 的核心特征：缝合线 (Sutures)。分为三类演化阶段：棱菊石 (Goniatite)、齿菊石 (Ceratitida)、菊石 (Ammonite)。

Slide 17

Visuals





Original Content

- Subclass Ammonoidea: (479.0—65.0 Ma) Sutures
- Sutures
- Orders
- Goniatite Ceratite Ammonite

🎓 讲师讲解

讲师讲解：

这里直观展示了三种缝合线图案：

1. **Goniatite**: 简单的折线。
 2. **Ceratite**: 有锯齿状的叶。
 3. **Ammonite**: 极其复杂的树枝状花纹。这就是判断地质年代的“指纹”。
-

Slide 18

Visuals



Original Content

- Ammonites

🎓 讲师讲解

讲师讲解：

典型的菊石化石照片，展示了其卷曲的外壳和肋条装饰。

Slide 19

Original Content

- Fossil Cephalopod Shells
- Ammonite shells were made of ARAGONITE
- Ammonite shells were “largely” ectochlilate (encapsulate the soft-tissue)
- Belemnite shells were made of LOW MAGNESIAN CALCITE (LMC)
- Belemnites were endochlilate (inside the soft tissue)

🎓 讲师讲解

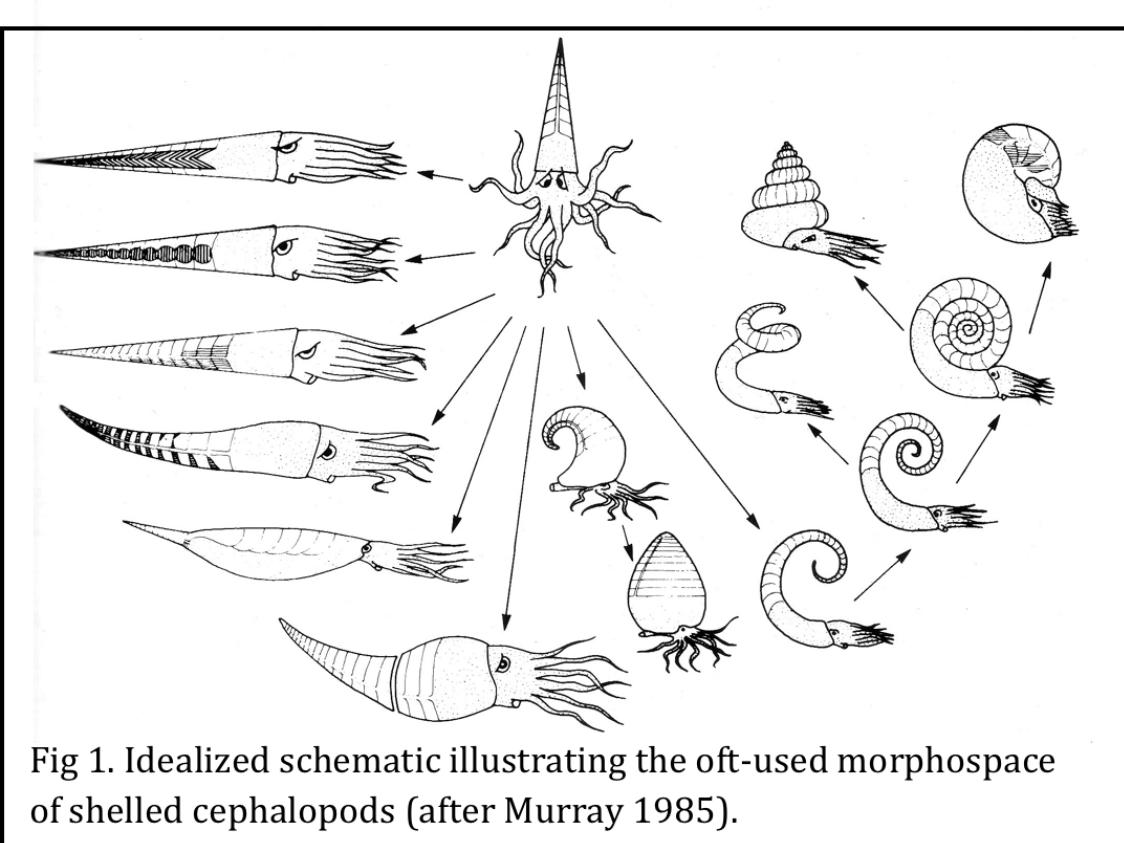
讲师讲解：

壳体对比：

- 菊石 (Ammonite): 文石 (Aragonite) 材质，外壳 (Ectocochlilate)。
 - 箭石 (Belemnite): 低镁方解石 (LMC) 材质，内壳 (Endocochlilate)。方解石更稳定，所以箭石保存得更好。
-

Slide 20

Visuals



Original Content

- Shelled Cephalopod Morphospace

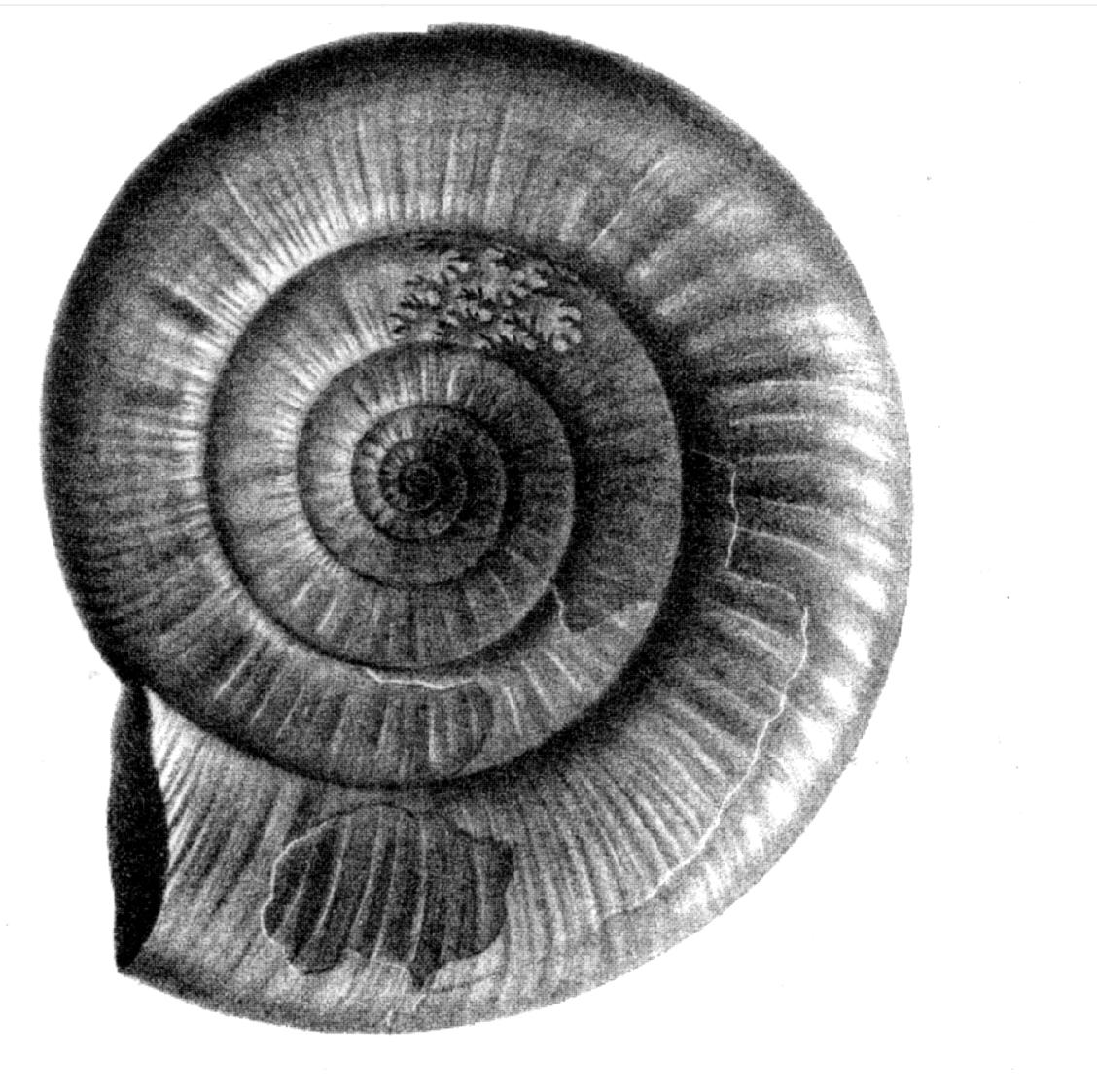
🎓 讲师讲解

讲师讲解：

这张图展示了带壳头足类的 **形态空间 (Morphospace)** 图表，用于分析演化趋势。

Slide 21

Visuals



Original Content

- Order Ammonitida

🎓 讲师讲解

讲师讲解：

真菊石目 (Order Ammonitida) 的示例。

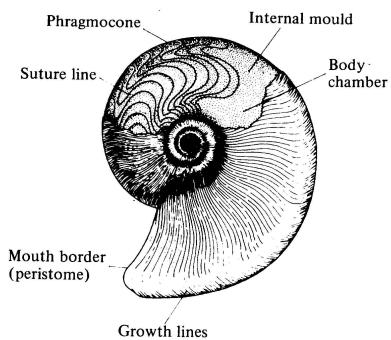
Slide 22

Visuals

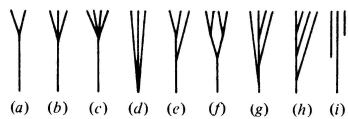
Ammonite Assessment

Sketch, label and give technical descriptions of the ammonites *Hildoceras*, *Dactylioceras* and *Amaltheus*

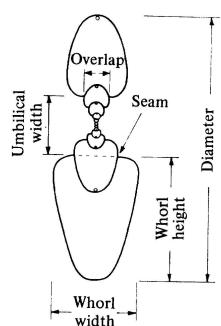
The following terms may be useful.



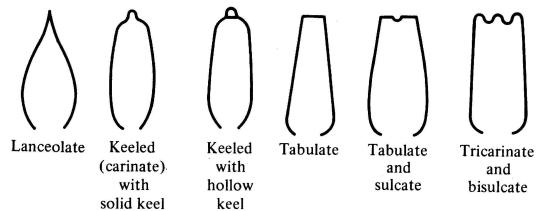
Types of ribbing



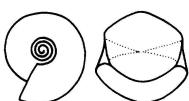
- (a) Bipartite (bifurcate)
 (b) Tripartite (trifurcate)
 (c) Quadripartite
 (d) Fasciopartite (fasciculate)
 (e) Polygyrate
 (f) Bidichotomous
 (g) Diversipartite
 (h) Virgatipartite (virgatotome)
 (i) Intercalated
 (After Schindewolf 1925)



Whorl sections



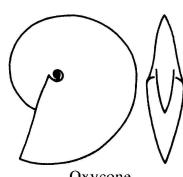
Shell shapes



Cadicone
(evolute = with wide umbilicus; depressed)



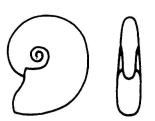
Sphaerocone
(involute = with narrow umbilicus; depressed)



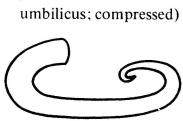
Oxycone
(involute = with narrow umbilicus; compressed)



Serpenticones
(evolute = with wide umbilicus; depressed)



Platycone
(planulate)

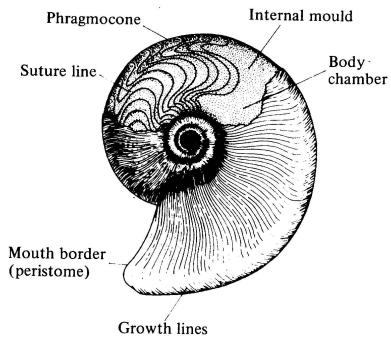


Heteromorph

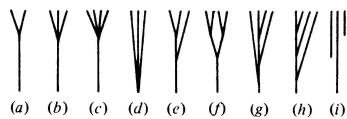
Ammonite Assessment

Sketch, label and give technical descriptions of the ammonites *Hildoceras*, *Dactylioceras* and *Amaltheus*

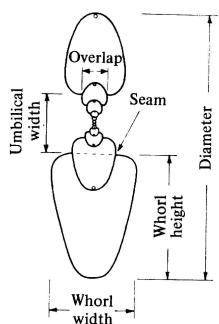
The following terms may be useful.



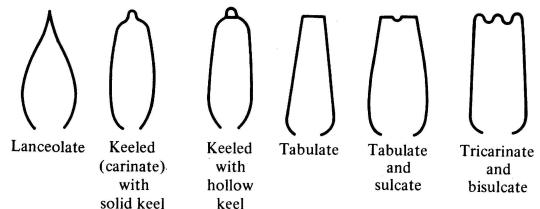
Types of ribbing



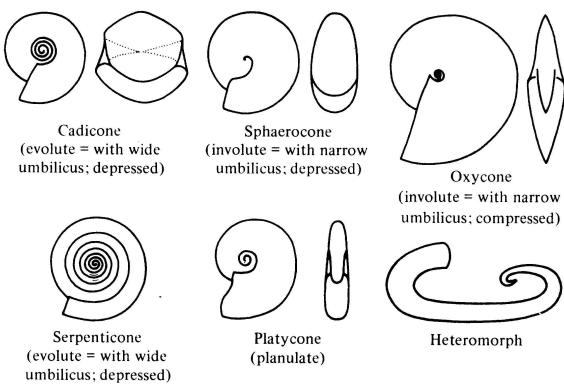
- (a) Bipartite (bifurcate)
 (b) Tripartite (trifurcate)
 (c) Quadripartite
 (d) Fasciopartite (fasciculate)
 (e) Polygyrate
 (f) Bidichotomous
 (g) Diversipartite
 (h) Virgatipartite (virgatotome)
 (i) Intercalated
 (After Schindewolf 1925)



Whorl sections



Shell shapes



Original Content

- Order Ammonitida

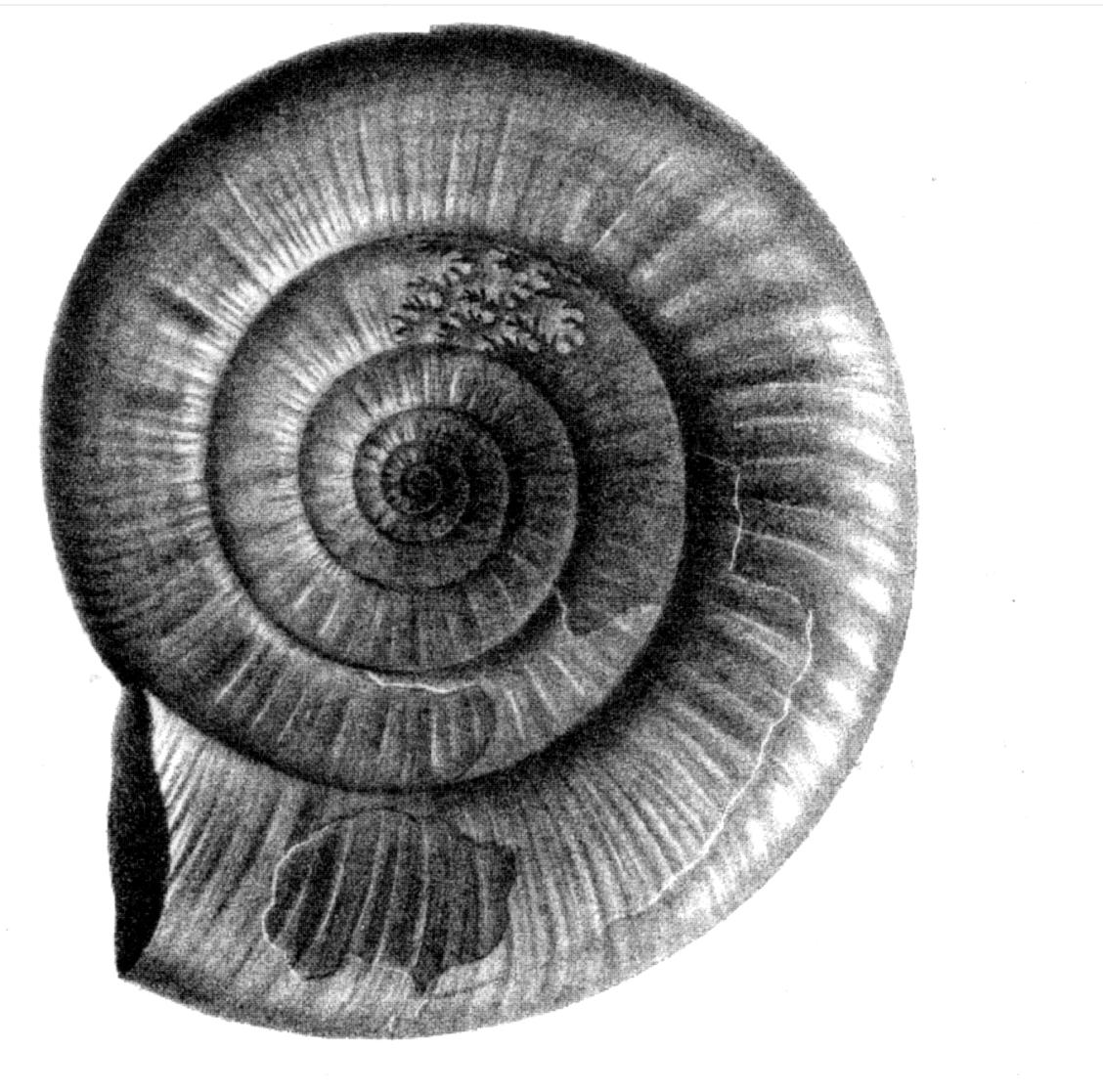
讲师讲解

讲师讲解：

更多真菊石目的化石样本与复原图。

Slide 23

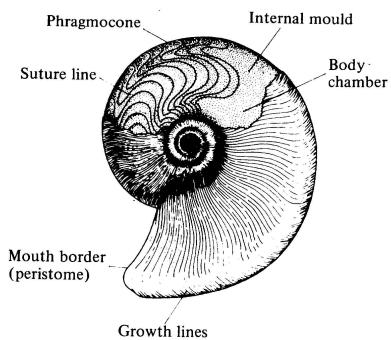
Visuals



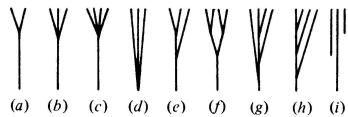
Ammonite Assessment

Sketch, label and give technical descriptions of the ammonites *Hildoceras*, *Dactylioceras* and *Amaltheus*

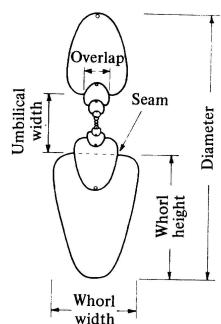
The following terms may be useful.



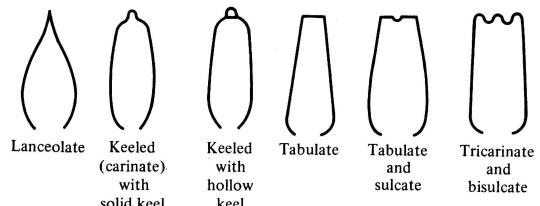
Types of ribbing



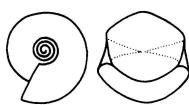
- (a) Bipartite (bifurcate)
 (b) Tripartite (trifurcate)
 (c) Quadripartite
 (d) Fasciopartite (fasciculate)
 (e) Polygyrate
 (f) Bidichotomous
 (g) Diversipartite
 (h) Virgatipartite (virgatotome)
 (i) Intercalated
 (After Schindewolf 1925)



Whorl sections



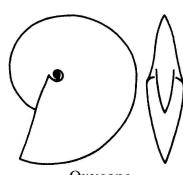
Shell shapes



Cadicone
 (evolute = with wide umbilicus; depressed)



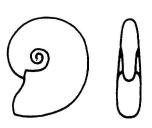
Sphaerocone
 (involute = with narrow umbilicus; depressed)



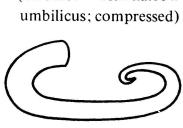
Oxycone
 (involute = with narrow umbilicus; compressed)



Serpenticones
 (evolute = with wide umbilicus; depressed)



Platycone
 (planulate)



Heteromorph

Original Content

- Coiling evolute involute

讲师讲解

讲师讲解：

卷曲形式 (Coiling)：

- **Evolute (旋卷/外卷)**：所有螺环都露在外面。
 - **Involute (内卷)**：外层螺环包住了内层。
-

Slide 24

Visuals



Original Content

- Parapuzosia seppenradensis → the largest ammonite ever found over 1.8m in diameter

🎓 讲师讲解

讲师讲解：

这是最大的菊石记录：Parapuzosia seppenradensis，直径超过 1.8米！

Slide 25

Original Content

- Cope's Rule
- Cope's Rule is the tendency for organisms in evolving lineages to increase in size over time.
- What benefits might this confer?
- What is it a rule for all lineages or a “tendency” for some?
- Look at the data in question 2 of the practical!

🎓 讲师讲解

讲师讲解：

柯普定律 (Cope's Rule): 生物世系在演化中体型趋于变大的理论。

- 思考：变大有什么好处？
 - 你们将在实习课中分析数据来检验这对菊石是否适用。
-

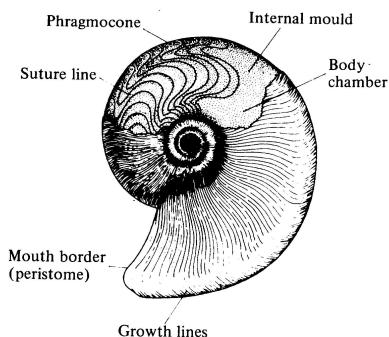
Slide 26

Visuals

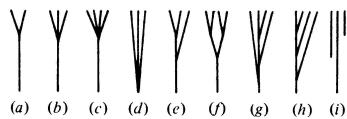
Ammonite Assessment

You are provided with one ammonite, *Hildoceras bifrons*, sketch, label and give a technical description.

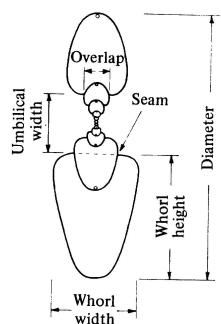
The following terms may be useful.



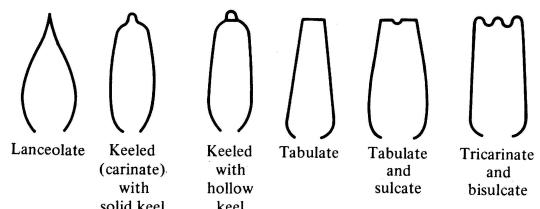
Types of ribbing



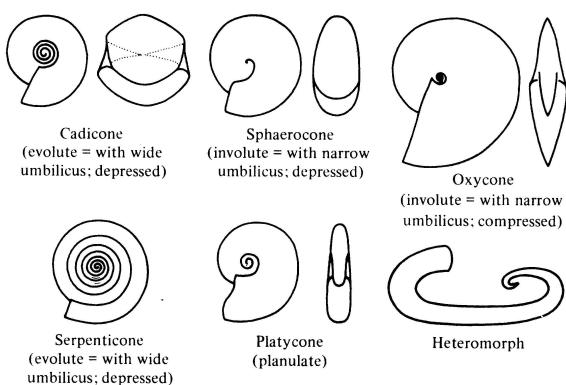
(After Schindewolf 1925)



Whorl sections



Shell shapes



Original Content

- Ammonoid Shell Form

讲师讲解

讲师讲解：

展示了菊石多变的壳体形态。

Slide 27

Original Content

- Ammonites Hydrodynamics

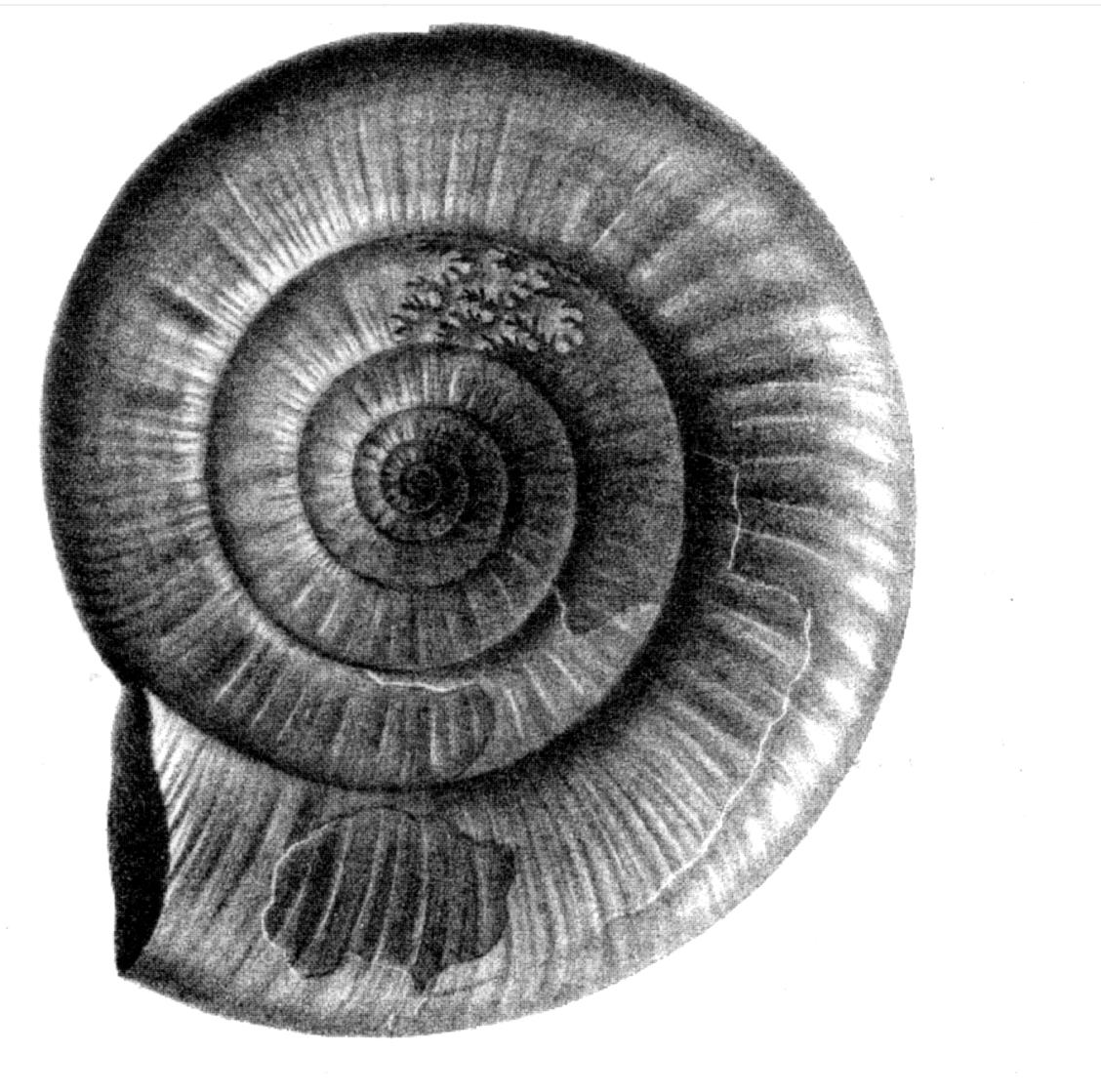


讲师讲解：

流体动力学 (Hydrodynamics): 研究菊石在水中的运动效率。

Slide 28

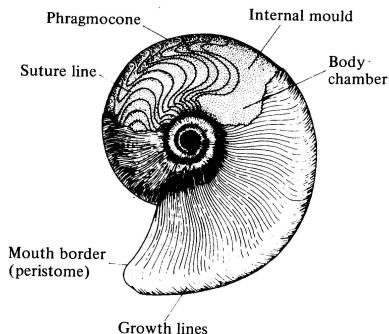
Visuals



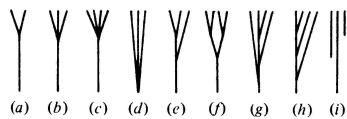
Ammonite Assessment

Sketch, label and give technical descriptions of the ammonites *Hildoceras*, *Dactylioceras* and *Amaltheus*

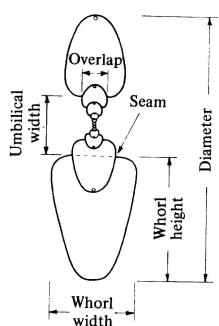
The following terms may be useful.



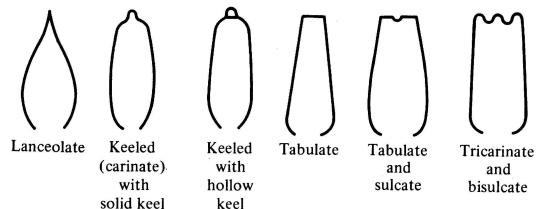
Types of ribbing



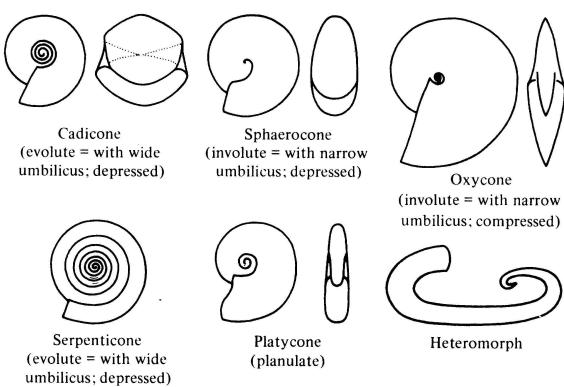
(After Schindewolf 1925)



Whorl sections



Shell shapes



Original Content

- Hydrodynamics? Evolute involute

讲师讲解

讲师讲解：

这里对比了 **旋卷 (Evolute)** 和 **内卷 (Involute)** 的流体性能。光滑的内卷壳体阻力更小，适合快速游动。

Slide 29

Original Content

- Ammonites: mode of life
- Modern Nautilus is nektonic.
- What is the evidence for mode of life in ammonites?

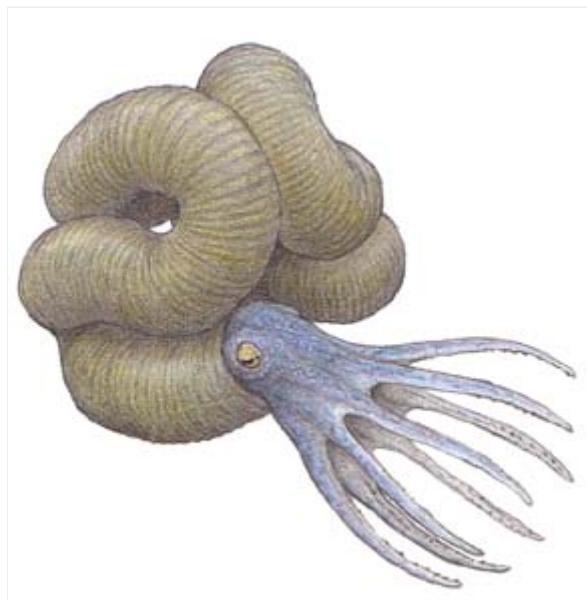


讲师讲解：

生活模式 (Mode of Life): 推测菊石也是游泳生物 (Nektonic)，但不同壳形可能适应不同的水层。

Slide 30

Visuals



Original Content

- Ammonites Heteromorphs

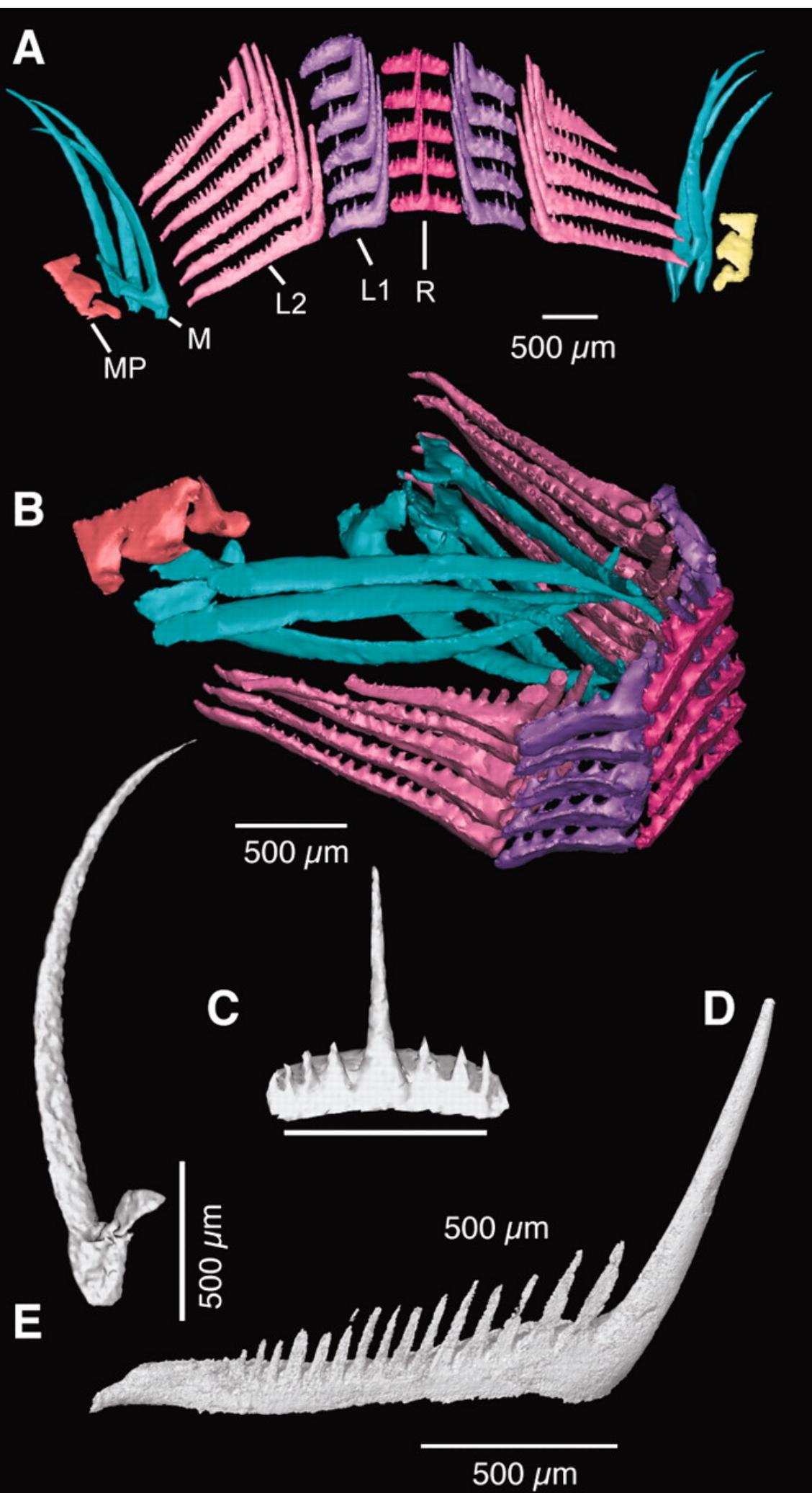
🎓 讲师讲解

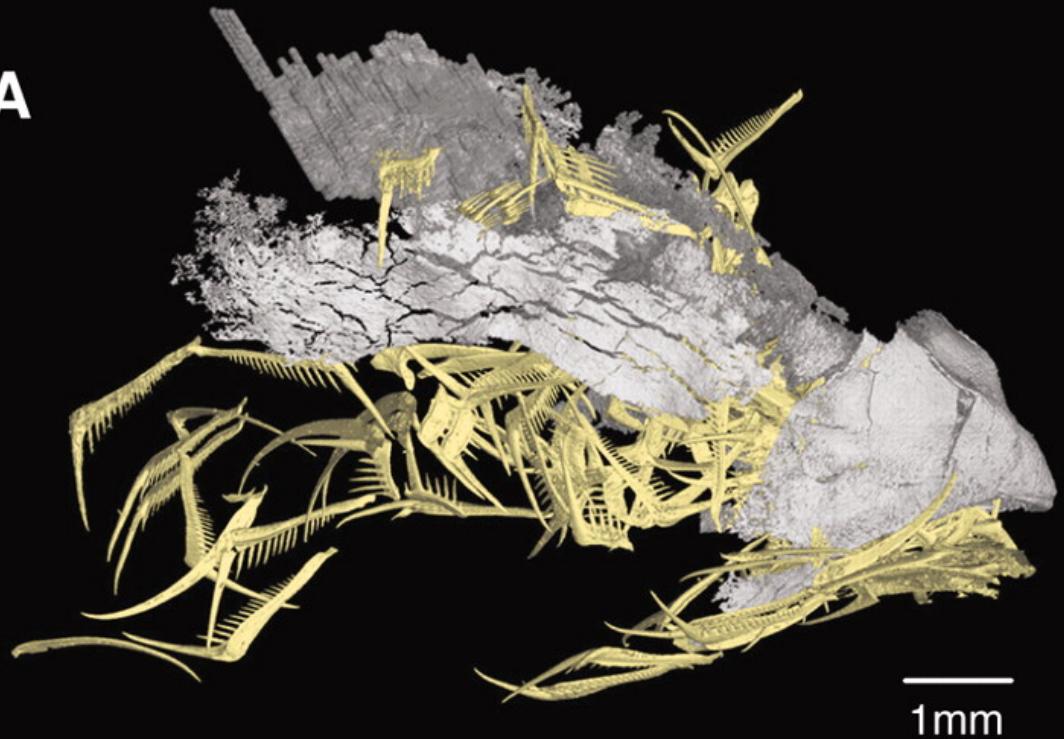
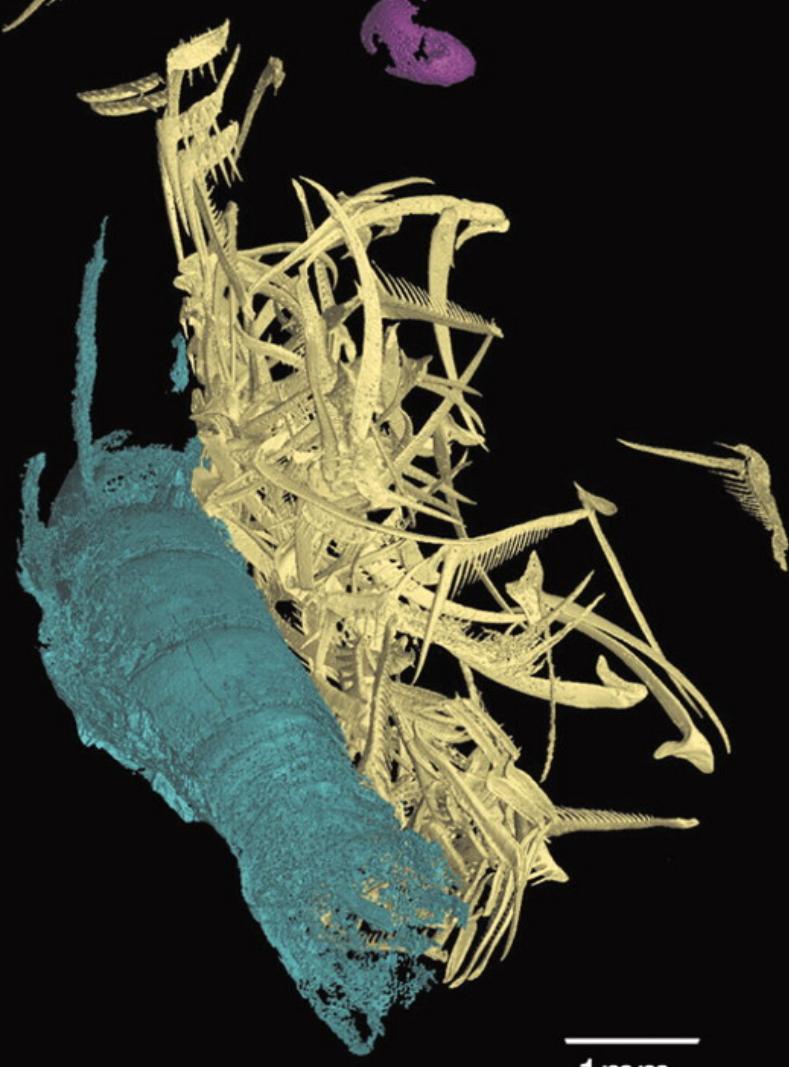
讲师讲解：

异形菊石 (Heteromorphs)：不规则卷曲的菊石。暗示它们可能是浮游或底栖生活，而非快速游泳。

Slide 31

Visuals



A**B**



Original Content

- Fig. 2 Morphology of the radula and teeth in *Baculites* sp.
- Kruta et al. Science 2011;331:70-72
- Published by AAAS

🎓 讲师讲解

讲师讲解：

一项重要发现 (Kruta et al., 2011)：在 **杆菊石 (Baculites)** 化石中发现了 **齿舌 (Radula)**，揭示了它们的食性。

Slide 32

Original Content

- Ammonites in the food chain



讲师讲解：

食物链 (Food chain): 菊石是中生代海洋食物网的关键一环。

Slide 33

Original Content

- Ammonites-Zone fossils
- Ammonites are zone-fossils par exellence
- Ammonite zones in the Jurassic are = to 1 million years
- Ammonite sub zones are equal to less than 80,000 years

🎓 讲师讲解

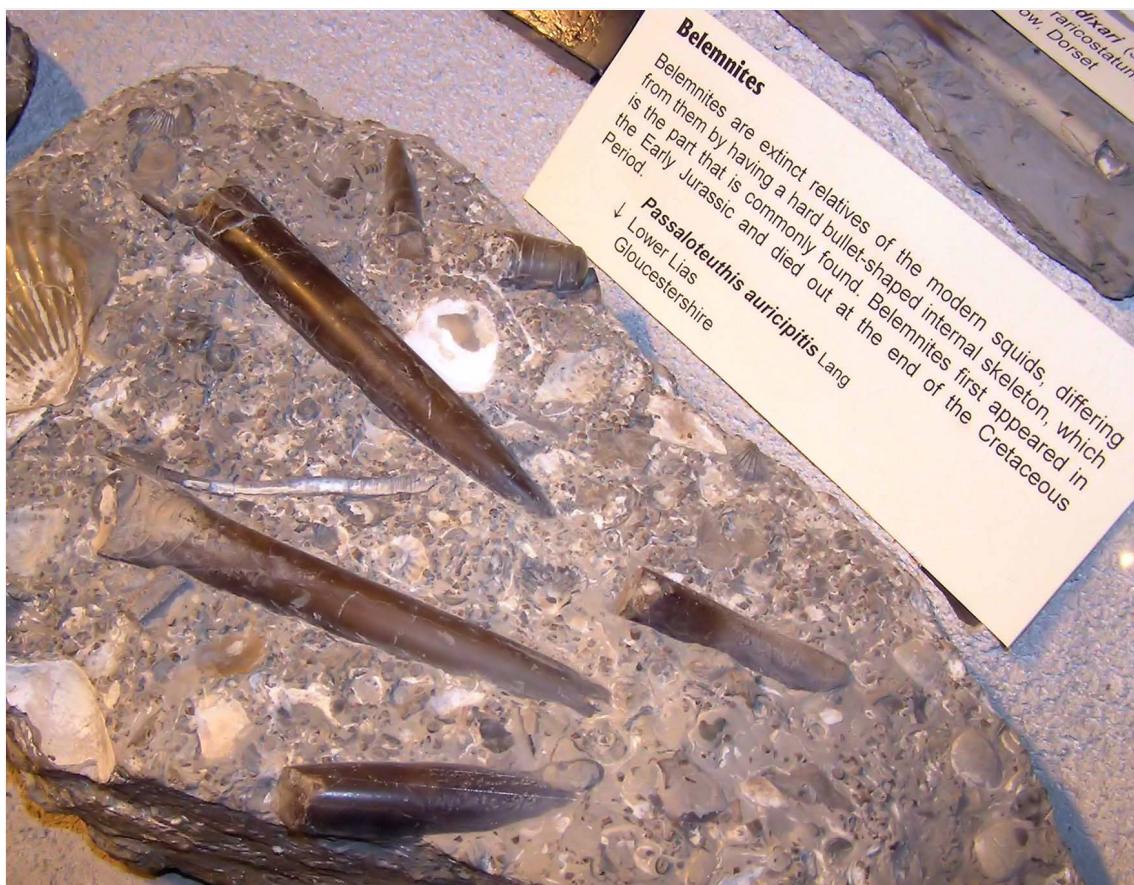
讲师讲解：

带化石 (Zone Fossils)：菊石是最好的带化石之一。

- **高精度**：侏罗纪的菊石带分辨率可达 100万年，亚带甚至小于 8万年。
-

Slide 34

Visuals



Original Content

- Belemnites

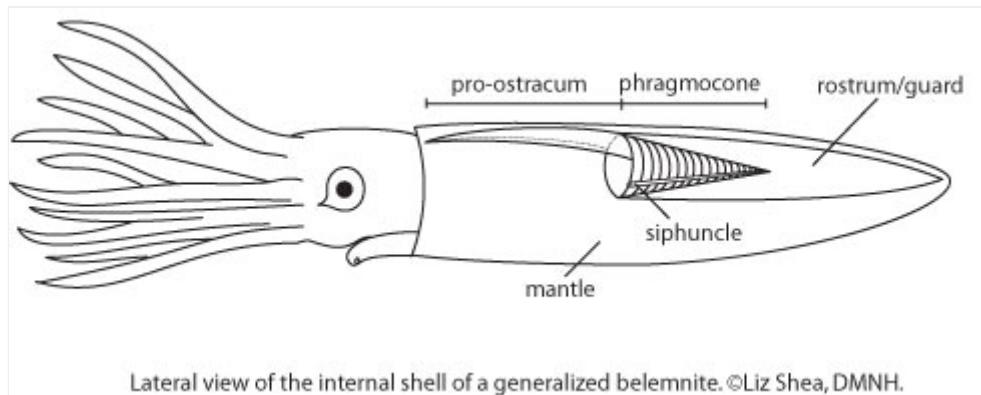
🎓 讲师讲解

讲师讲解：

箭石 (Belemnites) 的复原图，外形类似鱿鱼。

Slide 35

Visuals



Original Content

- Belemnites

🎓 讲师讲解

讲师讲解：

箭石化石中最常见的部分是 **护甲 (Guard)**，呈子弹状。

Slide 36

Original Content

- SEGMENT 3: Phylum Echinodermata
- Class Echinoidea
- Regularia
- Irregularia
- Class Crinoidea
- Class Holothuroidea
- Class Ophiuroidea
- Class Asteroidea

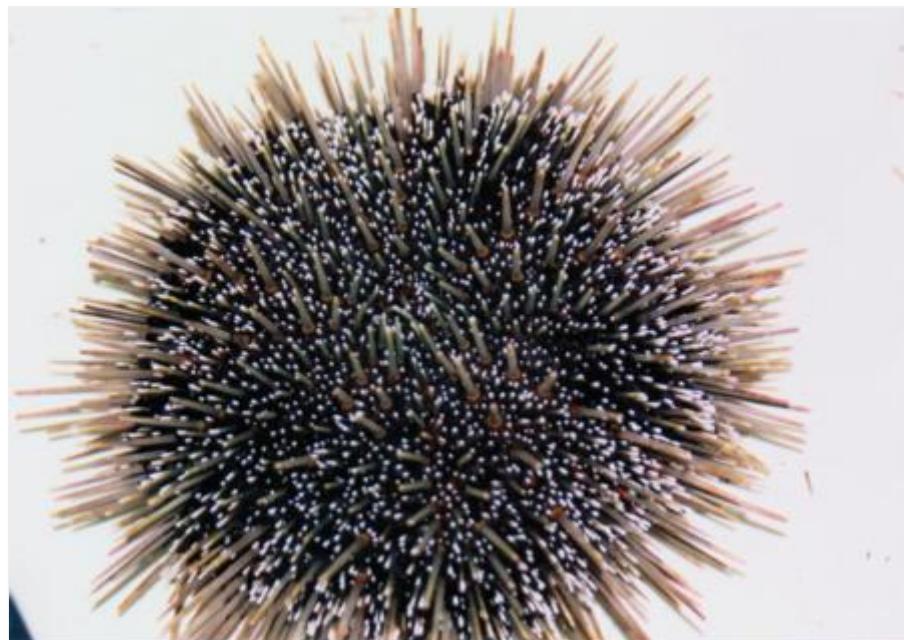
🎓 讲师讲解

讲师讲解：

第三部分：棘皮动物门（Echinodermata）。涵盖海胆、海百合、海参等。重点在 海胆纲（Echinoidea）。

Slide 37

Visuals





Original Content

- Phylum:Echinodermata (spiny skins)

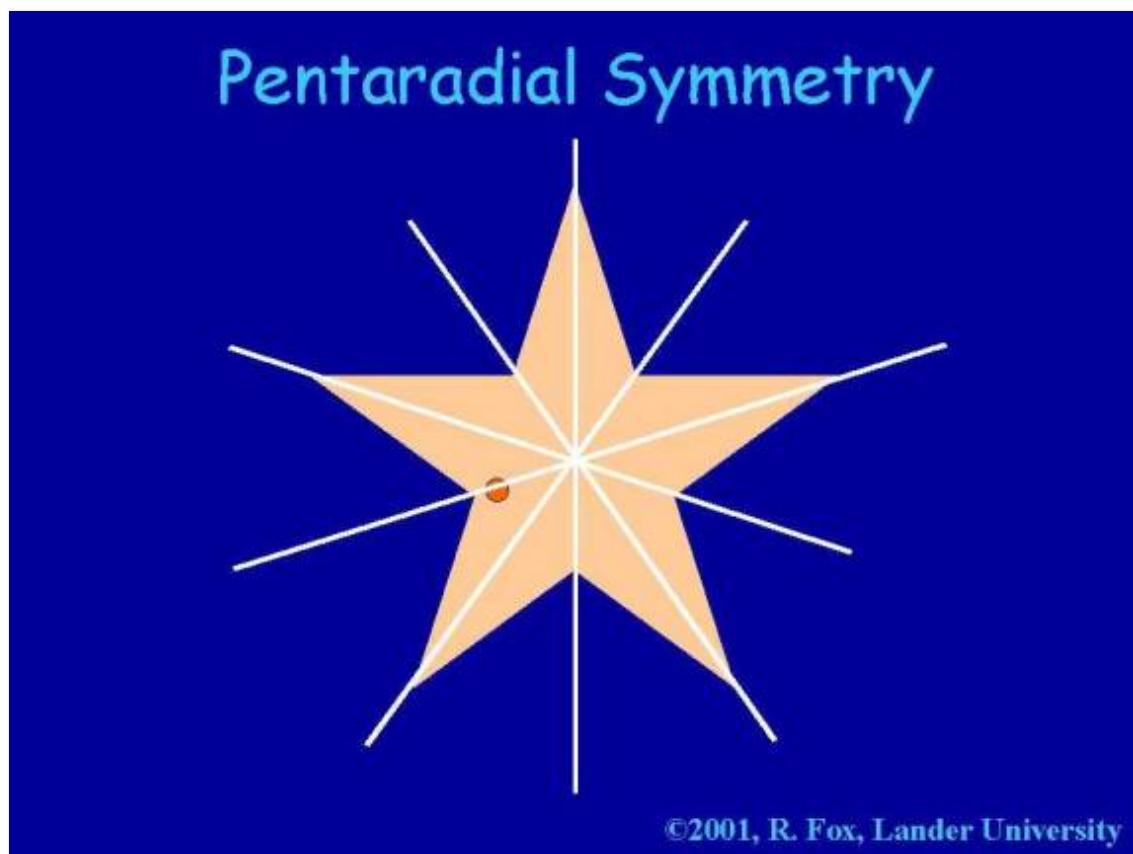
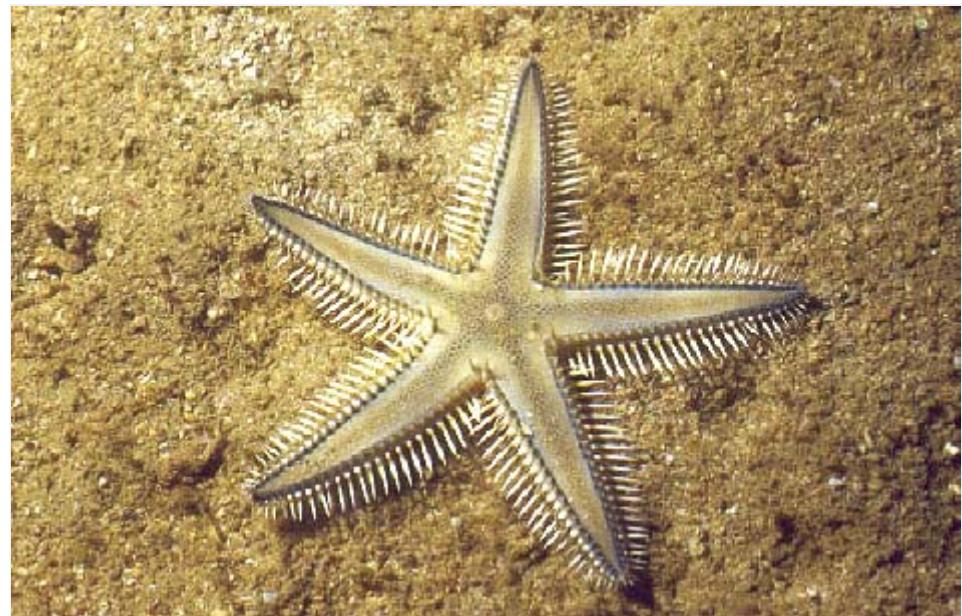
🎓 讲师讲解

讲师讲解：

棘皮动物意为 "Spiny skins" (棘皮)。

Slide 38

Visuals



Original Content

- Echinoderm characteristics

- Pentameral (5-fold) symmetry
- Not perfect as some features, mouth, anus, and madreporite can be non central
- Even where body is not pentaradial, elements of symmetry persist

🎓 讲师讲解

讲师讲解：

棘皮动物特征：

- **五辐射对称 (Pentameral symmetry)**：身体呈5部分对称。
-

Slide 39

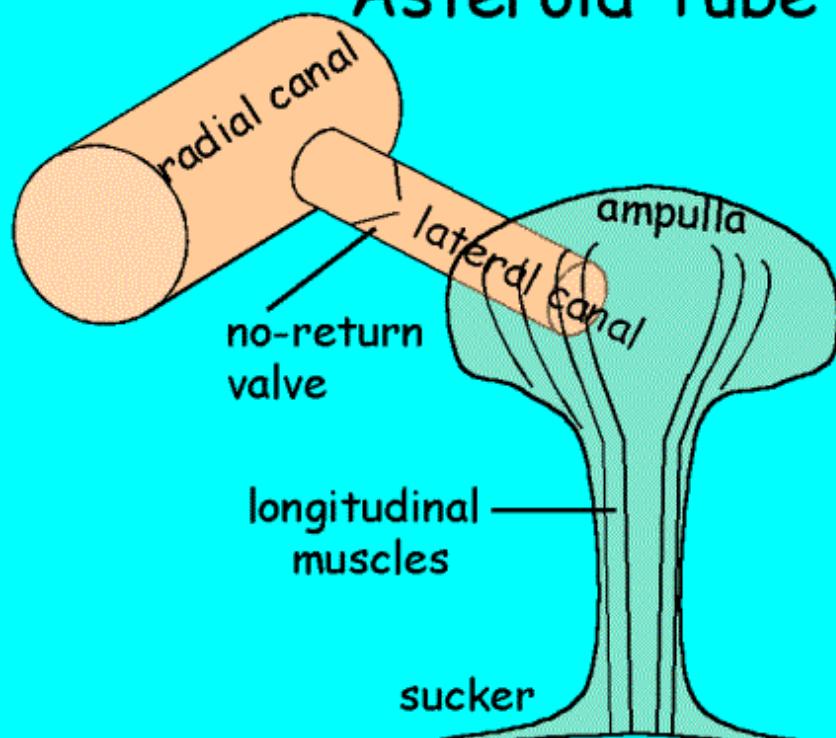
Visuals

Echinoderm Characteristics

3. Tube feet
Each one has a sucker at the end



Asteroid Tube Foot



Original Content

- Water-vascular system
- Tube feet used for movement and food acquisition and powered by hydraulic pressure

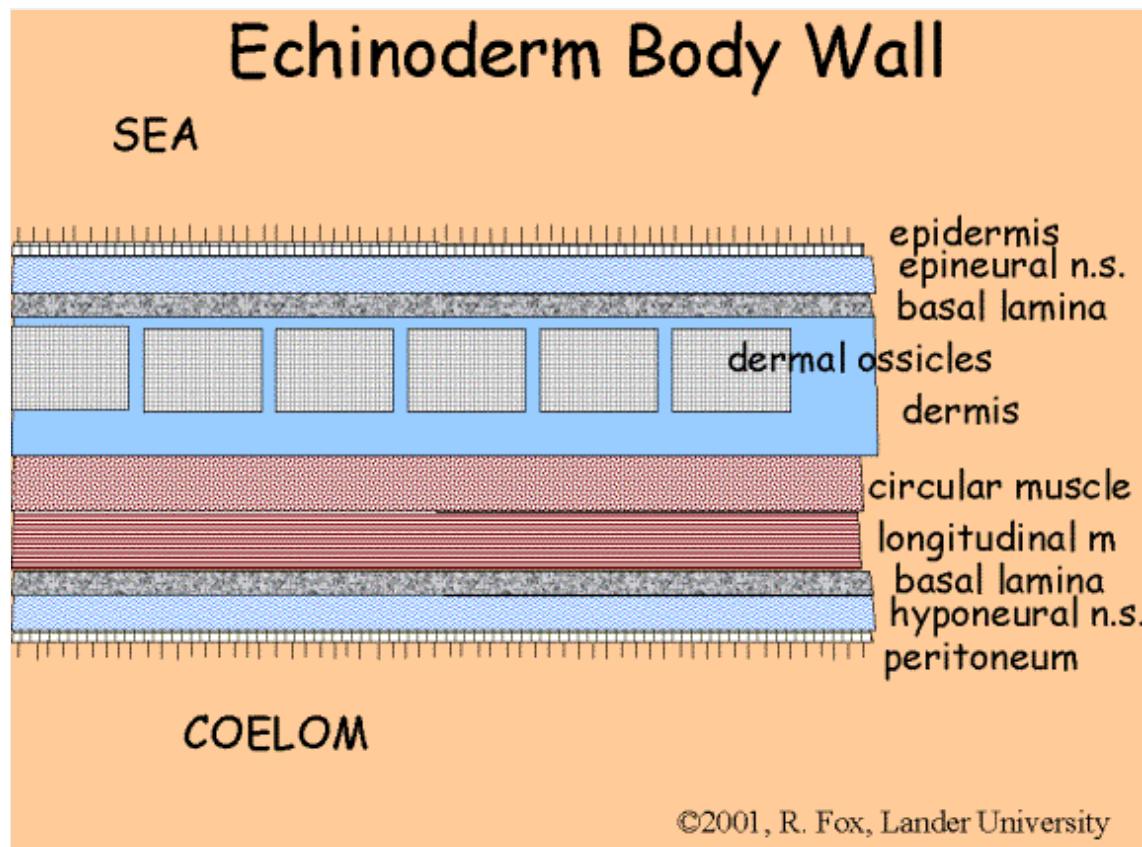
讲师讲解

讲师讲解：

水管系统 (Water-vascular system): 独特的液压系统，驱动 **管足 (Tube feet)** 运动。

Slide 40

Visuals



Original Content

- Echinoderm:construction

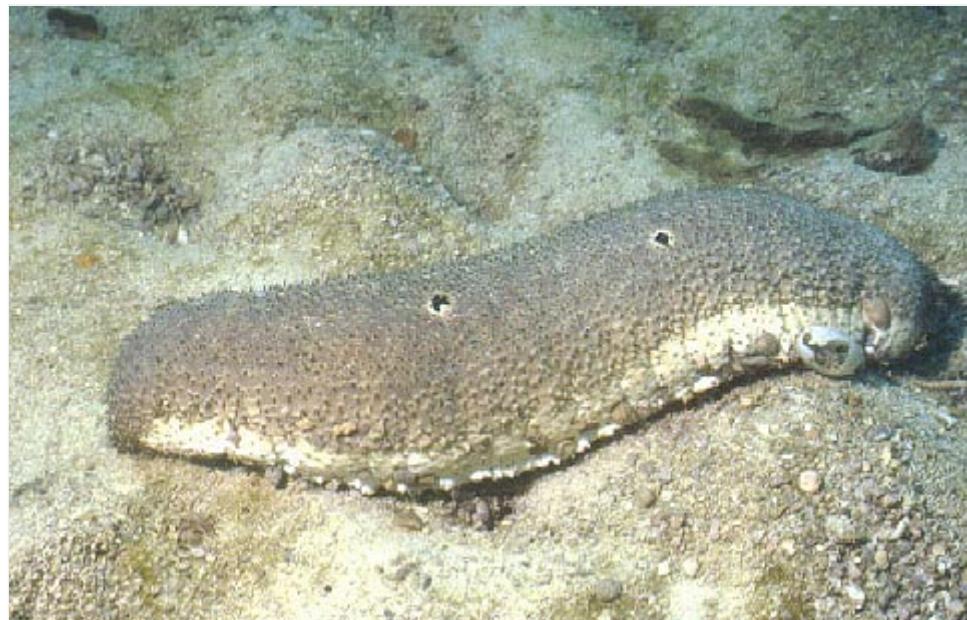
🎓 讲师讲解

讲师讲解：

展示了棘皮动物的骨架构造。

Slide 41

Visuals



Original Content

- Holothurians (Sea-cucumbers)

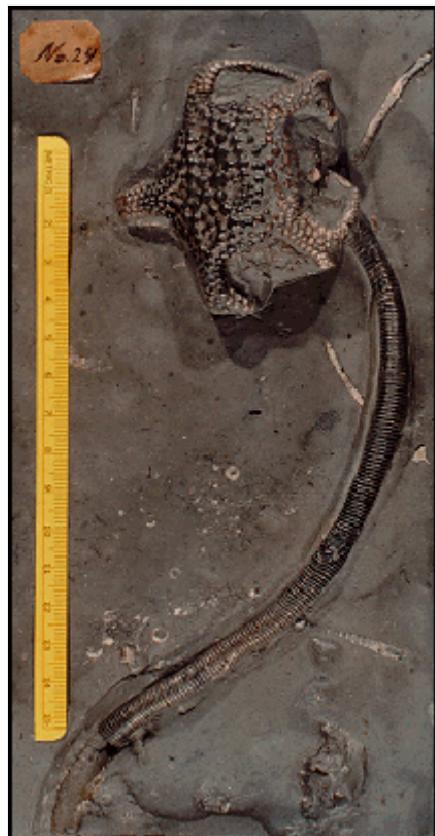


讲师讲解：

海参纲 (Holothurians)。

Slide 42

Visuals



Original Content

- Crinoidea

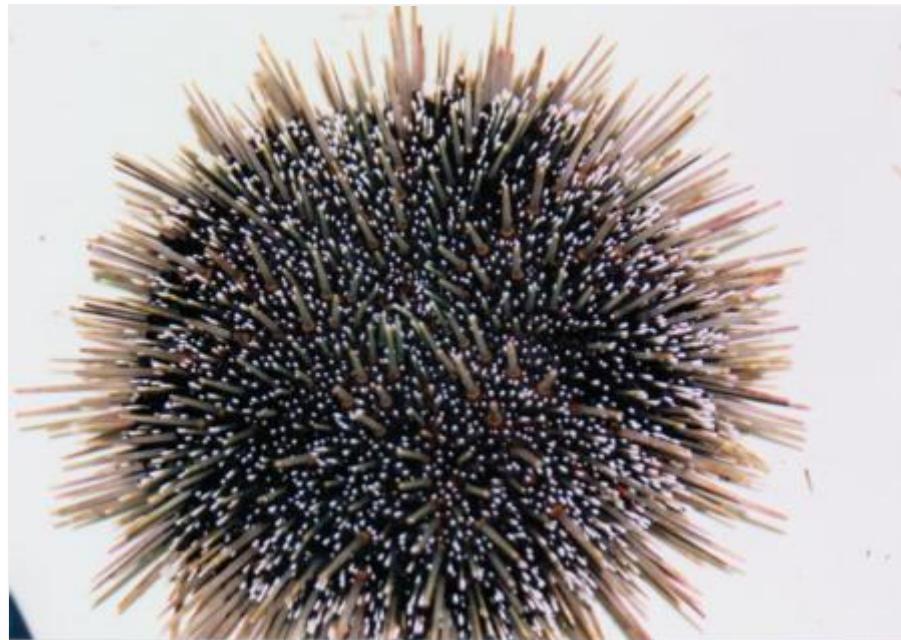


讲师讲解：

海百合纲 (Crinoidea)。

Slide 43

Visuals



Original Content

- Class:Echinoidea

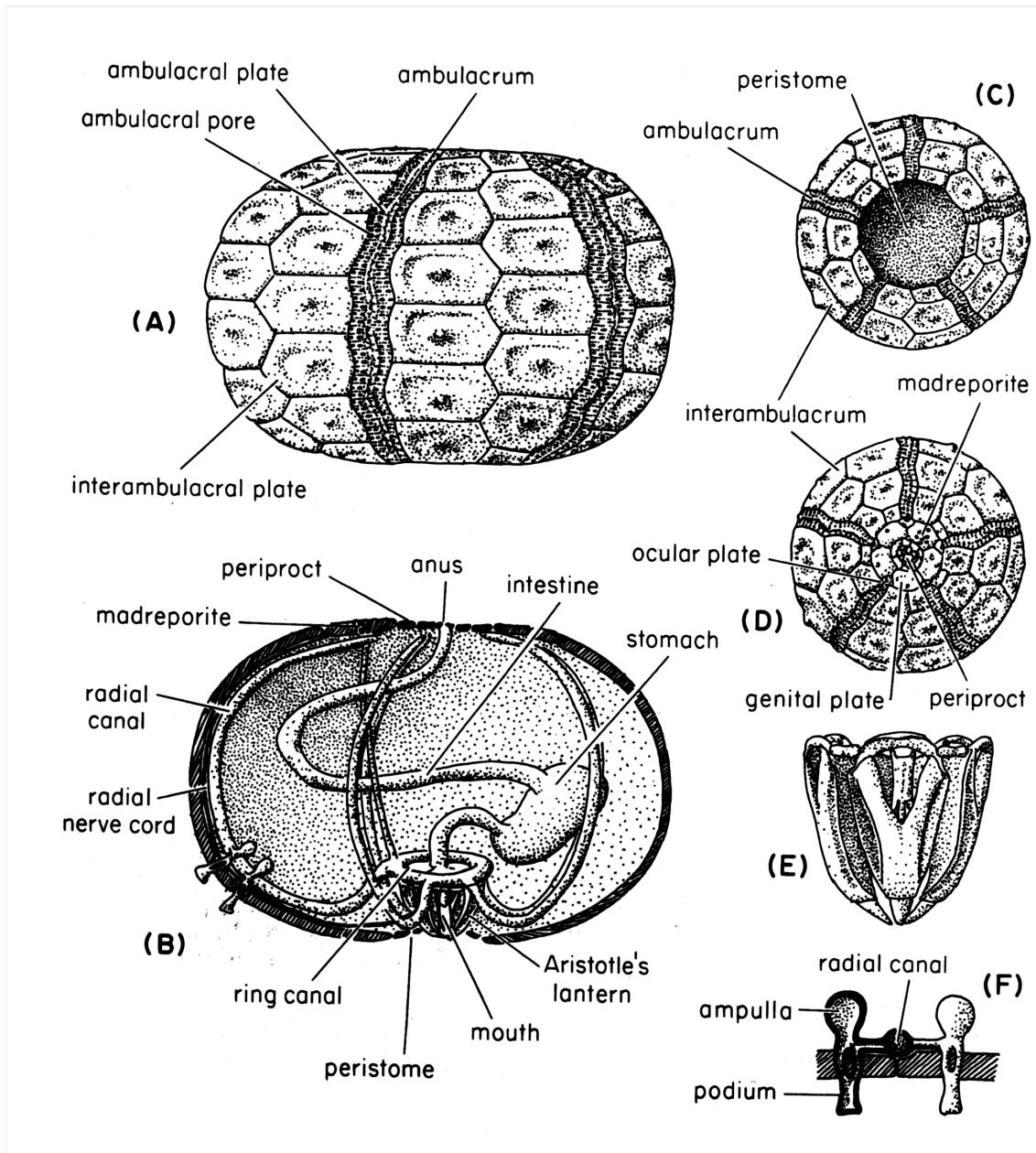
🎓 讲师讲解

讲师讲解：

海胆纲 (Echinoidea)。

Slide 44

Visuals



Original Content

- Echinoid test morphology

🎓 讲师讲解

讲师讲解：

海胆壳体形态 (Test morphology)。

Slide 45

Visuals



Original Content

- Echinoid test morphology

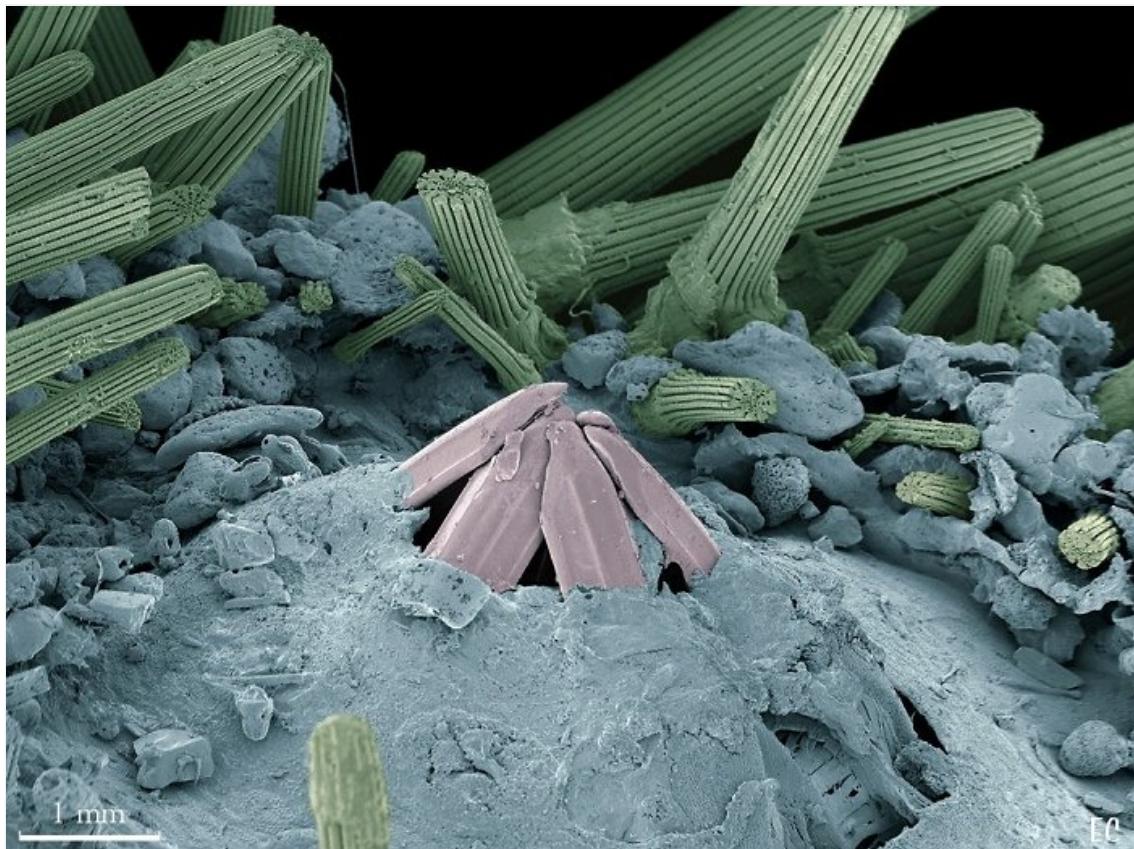
🎓 讲师讲解

讲师讲解：

海胆壳体的细节结构。

Slide 46

Visuals



Original Content

- Oral surface

🎓 讲师讲解

讲师讲解：

口面 (Oral surface)：海胆的底部。

Slide 47

Visuals



Original Content

- Teeth (Aristotle' s lantern)

🎓讲师讲解

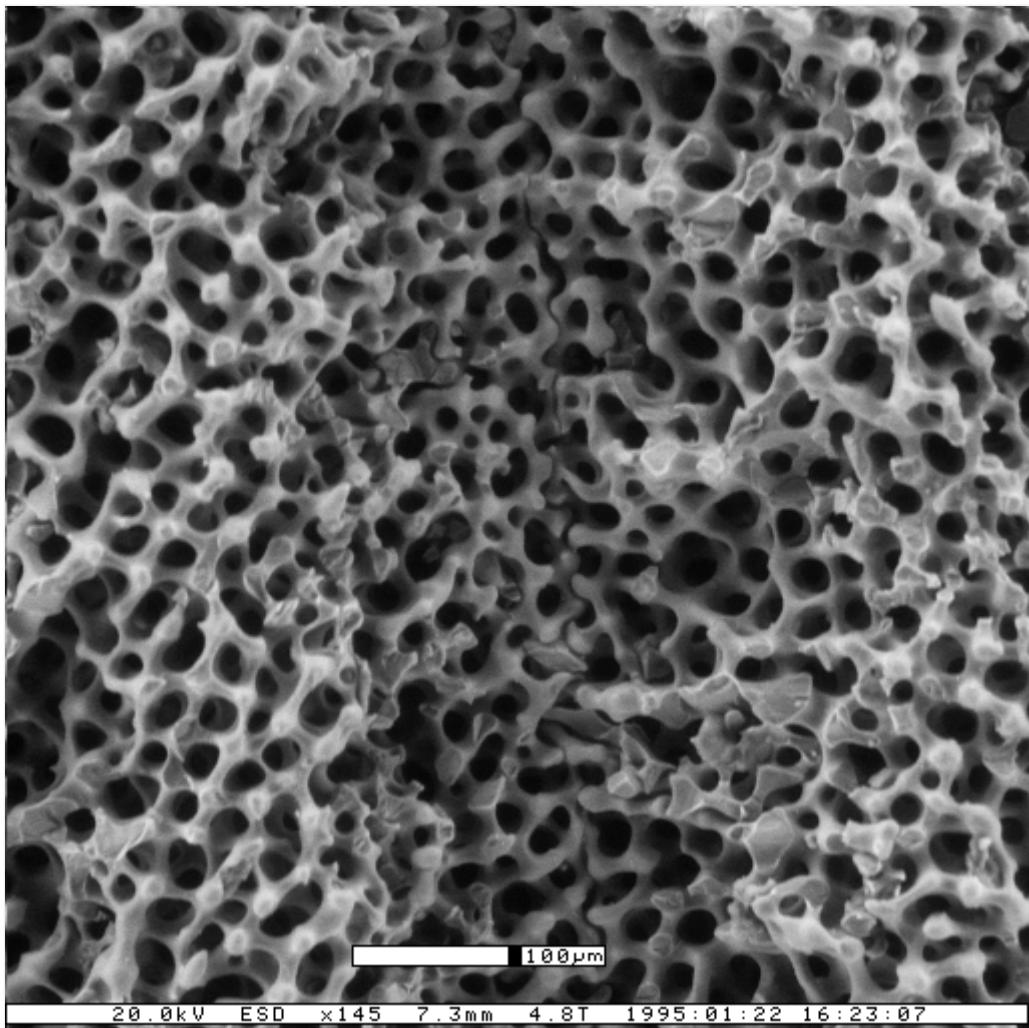
讲师讲解：

亚里士多德提灯 (Aristotle' s lantern): 海胆的咀嚼器官。

Slide 48

Visuals





Original Content

- Test construction (stereom)

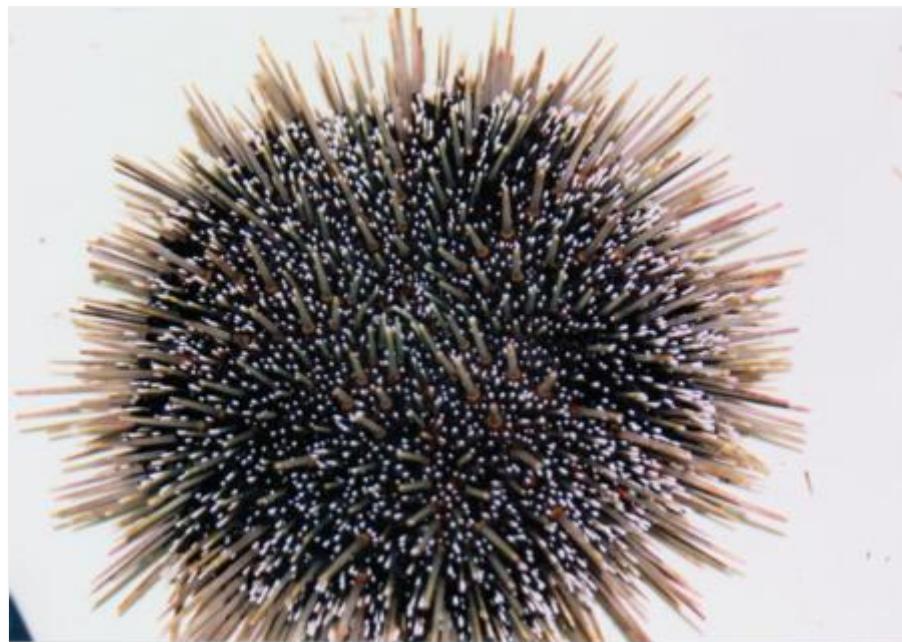
🎓 讲师讲解

讲师讲解：

骨架结构 (Stereom): 单晶方解石构成的多孔结构。

Slide 49

Visuals



Original Content

- Echinoid Symmetry

🎓 讲师讲解

讲师讲解：

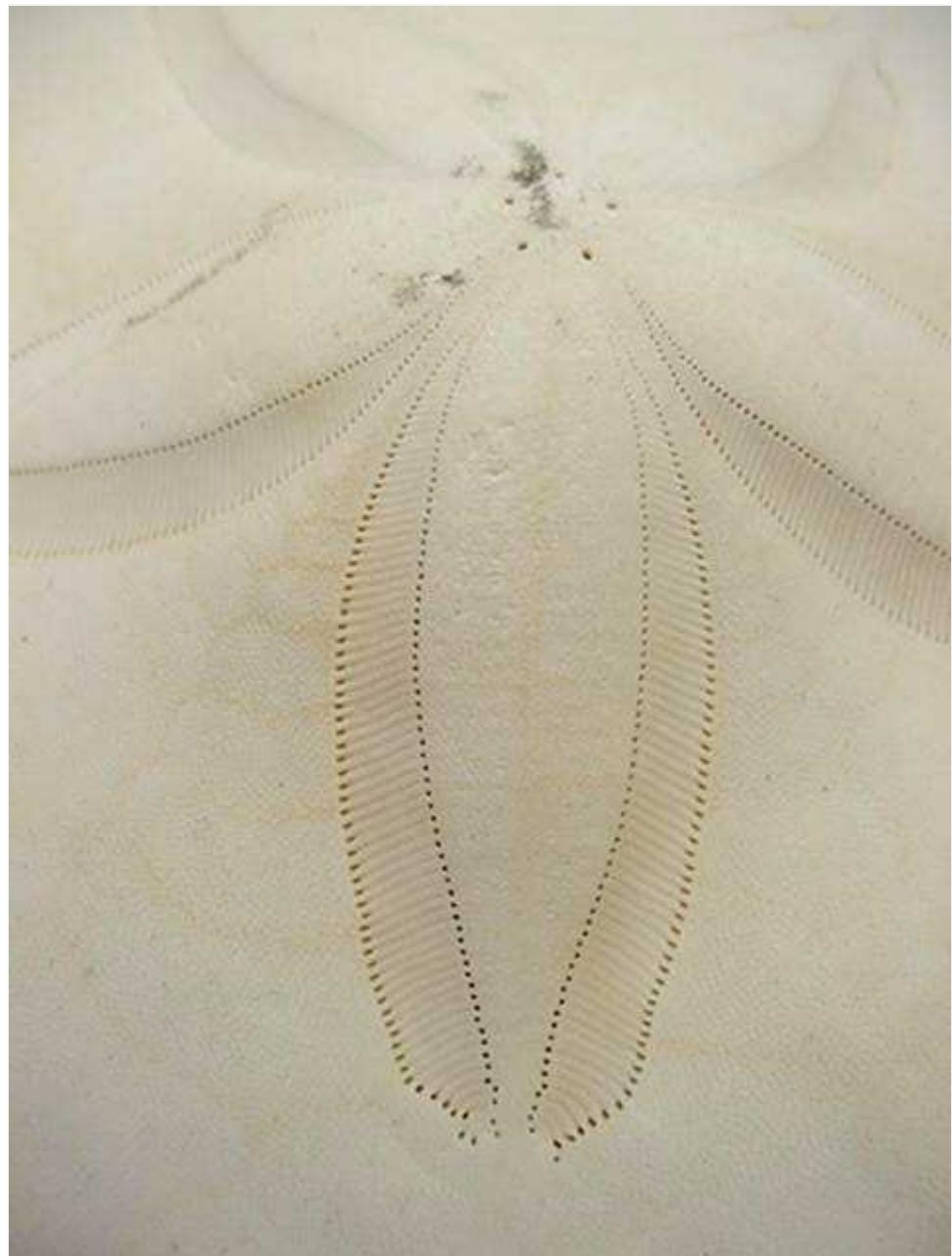
海胆对称性：

- **正形 (Regular)** 海胆（辐射对称）。
 - **歪形 (Irregular)** 海胆（次生两侧对称）。
-

Slide 50

Visuals







Original Content

- Irregularia



讲师讲解：

歪形海胆 (Irregularia)：适应在泥沙中挖掘生活 (Infaunal)，有了方向性。

Slide 51

Visuals

[Image 'Slide 51 Image 0' omitted: WMF format not supported in PDF generation]

Original Content

[No text detected]

🎓 讲师讲解

讲师讲解：

结束页。