

Lecture 2

Organizing the Diversity of Life

Organizing the Diversity of Life

- Approximately **1.8 million species** have been identified and named to date, and thousands more are identified each year.
 - Estimates of the total number of species that actually exist range from 10 million to over 100 million.
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Grouping Species: The Basic Idea

- **Taxonomy** is the branch of biology that names and classifies species into groups of **increasing breadth**.
تصنيف *فرع* *د* *اتساع متزايد*
- A **taxonomic hierarchy** is a system for classifying and organizing living organisms into a series of ranked categories, from the broadest (Domain) to the most specific (Species), to show their relationships and similarities.
الاتساع *علاقات* *مشابهات* *التفاوت*
- Domains, followed by kingdoms, are the broadest units of classification
أعلى مستويات تصنيف

نطاق مملكة شعبيّة طائفة رتبة فصيلة جنس فصيلة
 Domain Kingdom Phylum Class Order Family Genus Species

أمريكي
americanus

(American black bear)

Ursus
 دب

Ursidae
 فصيلة الدببة
 اسم

Carnivora
 كلات اللحوم

Mammalia
 الثدييات

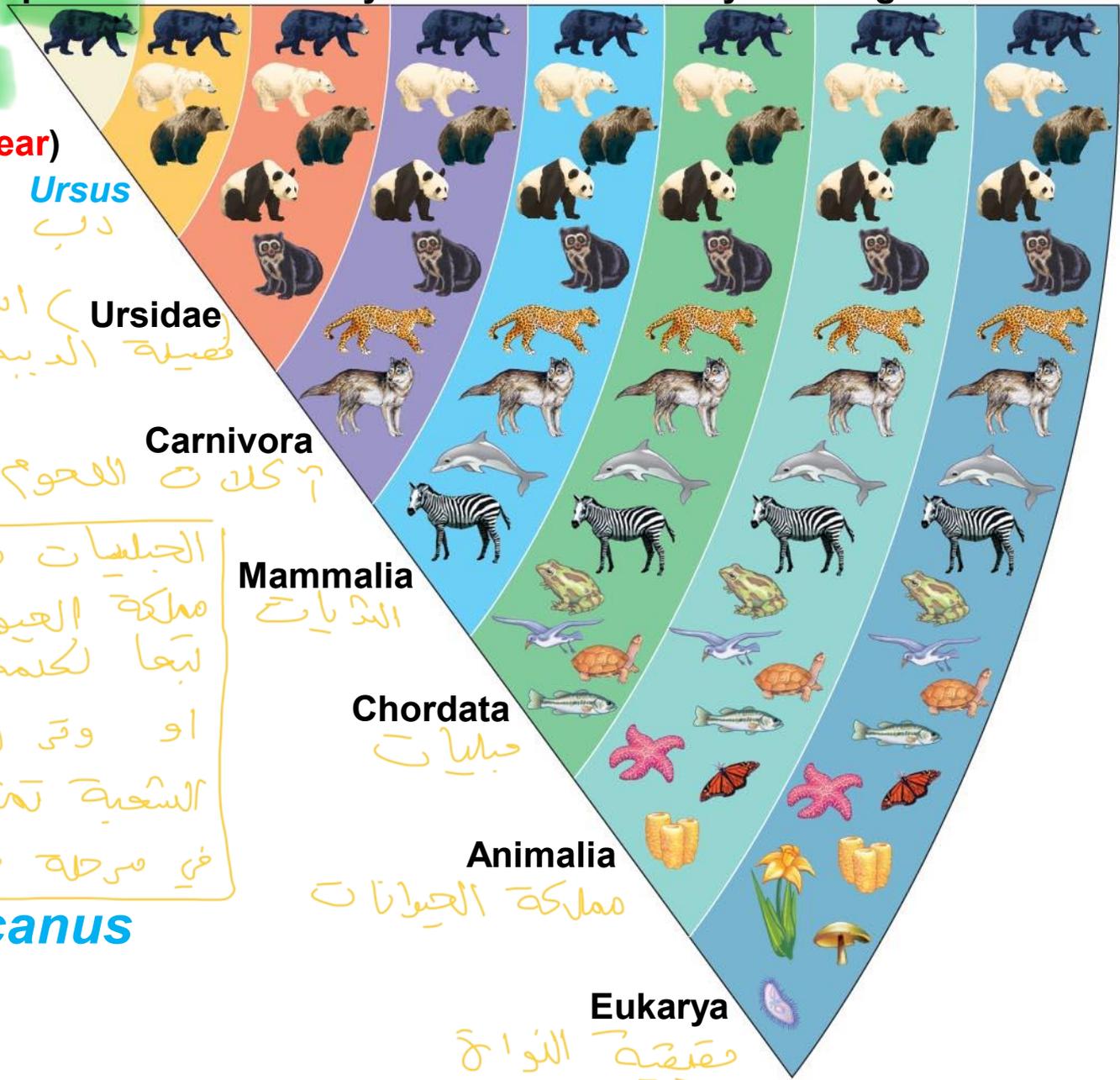
Chordata
 حبليات

Animalia
 مملكة الحيوانات

Eukarya
 فصيلة النواة

الجليات هي شعبيّة من مملكة الحيوان رسميت بذلك تبعاً لكلمة chord بمعنى حبل أو وتر لجميع حيوانات هذه الشعبة تمتلك حبل ظهري سواء في مرحلة ما أو طيلة حياتهم

Ursus americanus



Homo sapiens

الاسم العلمي للإنسان



صَفِيحَةُ النُّوَاةِ
(Organisms with membrane-bound nucleus)
Eukarya

مِنَ الحَيَوَانَاتِ
(Animals)
Animalia

مِنَ الحَبَلِيَّاتِ (الْحَمُورِ الْفَتْرِيِّ)
(Have a backbone)
Chordata

مِنَ المَمْلُوكَاتِ
(Have fur & give milk)
Mammalia

مِنَ الرِّثِيَّاتِ
(Have nails, short snouts, large brains)
Primate

الْقَرَدَةُ العَلِيَا
(Great Apes)
Hominidae

كَلِمَةٌ لَاتِيْنِيَّةٌ مَعْنَاهَا الْإِنْسَانُ
(Humans & related extinct species)
Homo

الْإِنْسَانُ العَاقِلُ
(Modern humans)
sapiens

المجال Domain

المملكة Kingdom

الشعب Phylum

فئات Class

الرتبة Order

العائلة (فصيلة) Family

الجنس Genus

نوع Species

The Three Domains of Life

بكتيريا
3 فصيلة النواة بدائية

- The three-domain system is currently used, and replaces the **old five-kingdom system** which are: animal, plant, fungi, protist, and monera.

5 ممالك
حيوان نبات فطريات طلائعيات

وحيدات خلايا

- **Domain Bacteria**

بدائيات

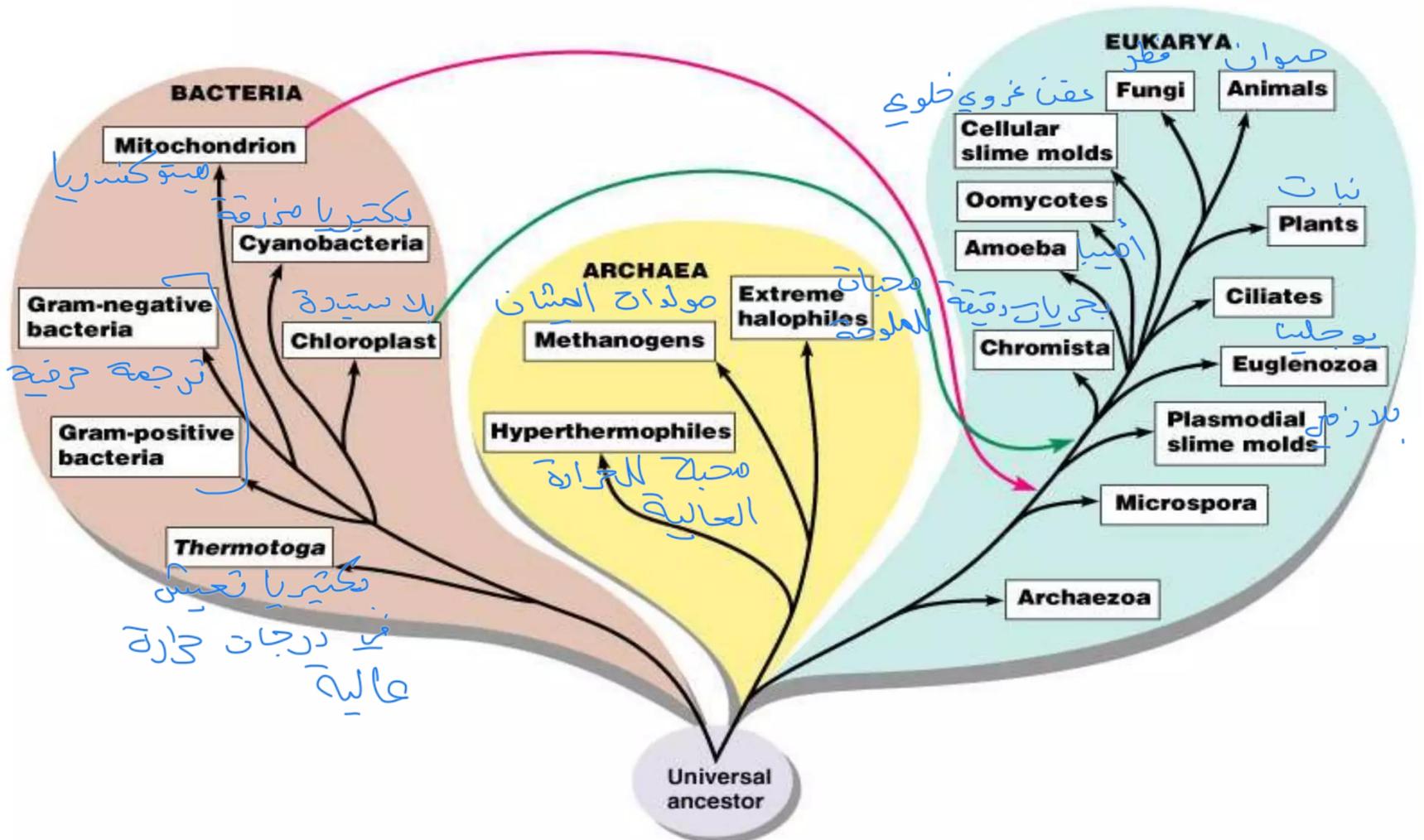
- **Domain Archaea** comprise the prokaryotes

بدائيات النواة
النواة قبل

- **Domain Eukarya** includes all eukaryotic organisms

حقيقيات النواة

The Three Domains



Five Kingdom System

1. Animalia
2. Plantae
3. Fungi
4. Protista
5. Monera



SIX Kingdom System



-
- The domain **Eukarya** includes three multicellular kingdoms:
 - Plantae
 - Fungi
 - Animalia
 - Other eukaryotic organisms were formerly grouped into a kingdom called **Protista**, though these are now often grouped into many separate kingdoms
-

Protists

- **Producers, consumers, decomposers.**
- Are simple eukaryotic organisms that are neither plants nor animals or fungi.
- Are unicellular in nature but can also be found as a colony of cells.
- Most protists live in water, damp terrestrial environments or even as parasites (*Amoeba*).
- Example:
 - **Protozoans** are unicellular organisms.
 - Historically, protozoans were called “animal”

protists showed animal-like behaviours.

because

Unity in the Diversity of Life

- **Evolution** explains both **unity** (shared traits) and **diversity** (adaptation).
 - ✓ **Unity**: all organisms share DNA as genetic materials and similar cellular structure.
 - ✓ **Diversity**: differences arise from adaptation to specific environments.

Charles Darwin and the Theory of Natural Selection

الانتخاب الطبيعي

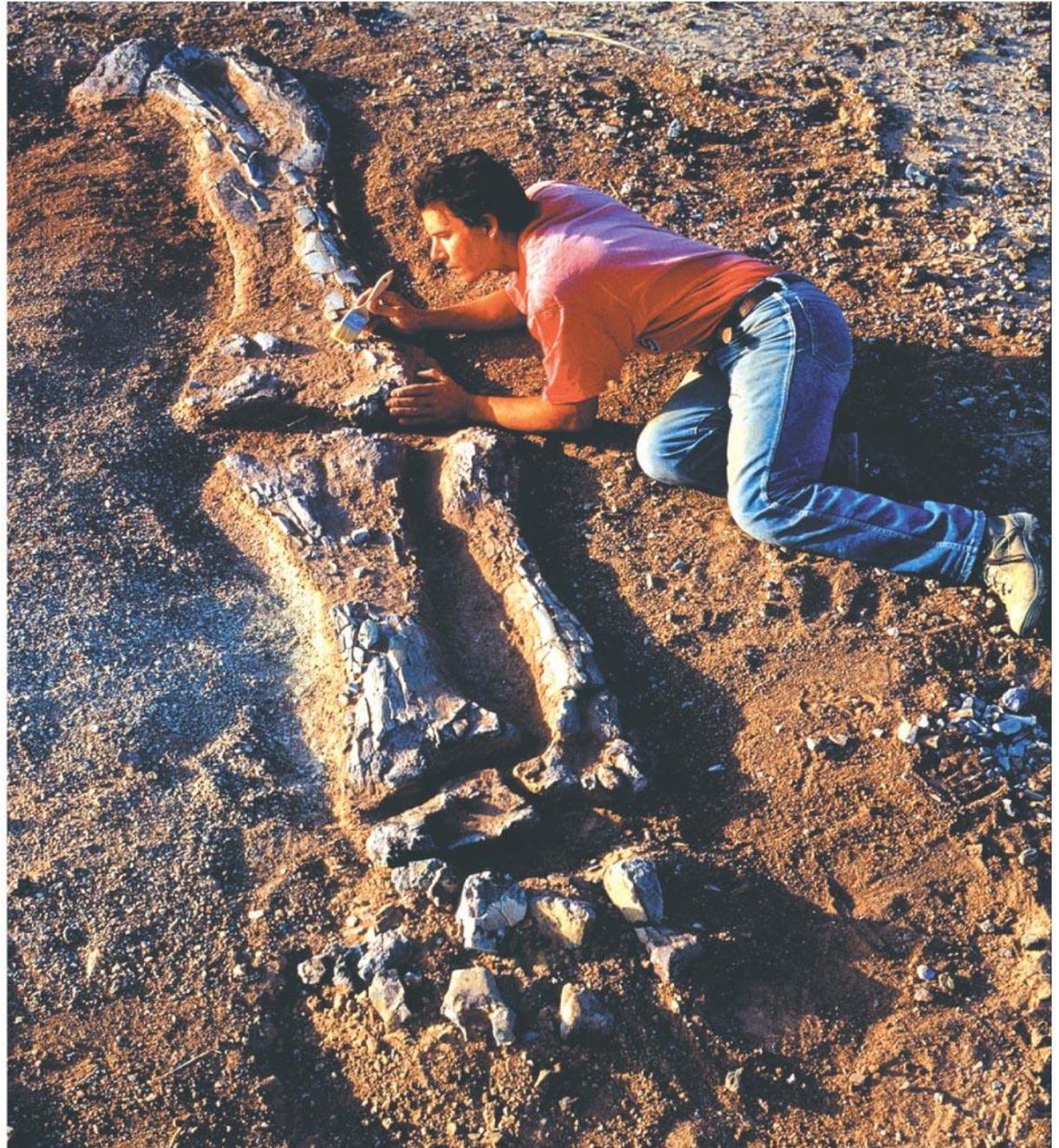
أحافير

أرض

- **Fossils** and other evidence document the evolution of life on Earth over billions of years

Digging into the past

الحفر بالماضي



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- Charles Darwin published *On the Origin of Species by Means of Natural Selection* in 1859
 - Darwin made two main points:
 - Species showed evidence of “descent with modification” from common ancestors
تغيّرات أو تعدّلات
أسلاف مشتركة
 - **Natural selection** is the **mechanism** behind “descent with modification”
الرابطة الشاغية
 - Darwin’s theory explained the duality of unity and diversity
-

- Darwin observed that:

- Individuals in a population have traits that vary ^{تختلف}
 - Many of these traits are heritable (passed from parents to offspring) ^{وراثية}
 - More offspring are produced than survive ^{الأجيال اللاحقة}
 - Competition is inevitable ^{تصية}
 - Species generally suit their environment
-

- Darwin inferred that:

- Individuals that are best suited to their environment are more likely to survive and reproduce.
أكثر تكيف
تكاثر
نجاة

- Over time, more individuals in a population will have the advantageous traits.
مميزات / أخفليق

- In other words, the natural environment “selects” for beneficial traits

تختار

صفات أكثر نفعاً

(التكيف دليل على الانتخاب الطبيعي)

- Natural selection is often evident in adaptations of organisms to their way of life and environment
- جناح الخفاش Bat wings are an example of adaptation during **Eocene** before 60 mys.

العصر الايوسيني

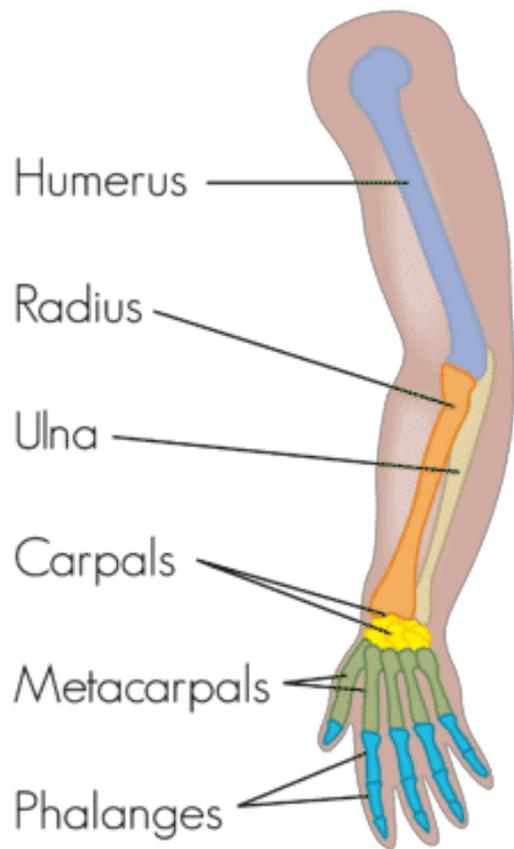


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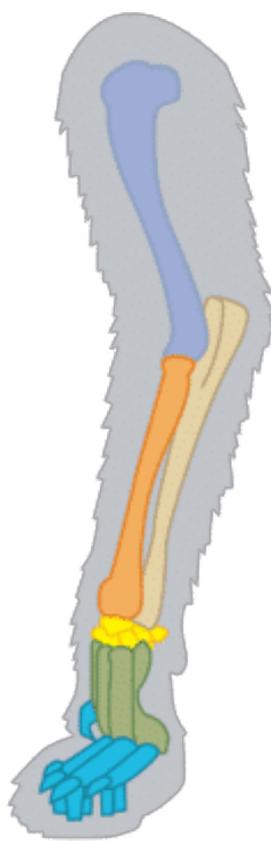
The Tree of Life

- “Unity in diversity” arises from “descent with modification”
النسب مع التغير
- For example, the forelimb of the bat, human, horse and the whale flipper all share a common skeletal architecture
مؤلف أعضائي
ميكمل مجامد مشترك
- Fossils provide additional evidence of anatomical unity from descent with modification

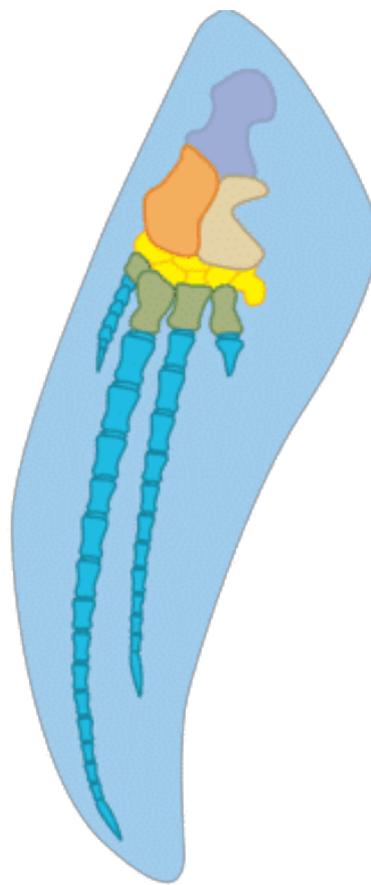
الحفريات دليل على التشابه بالكسبات



HUMAN



CAT

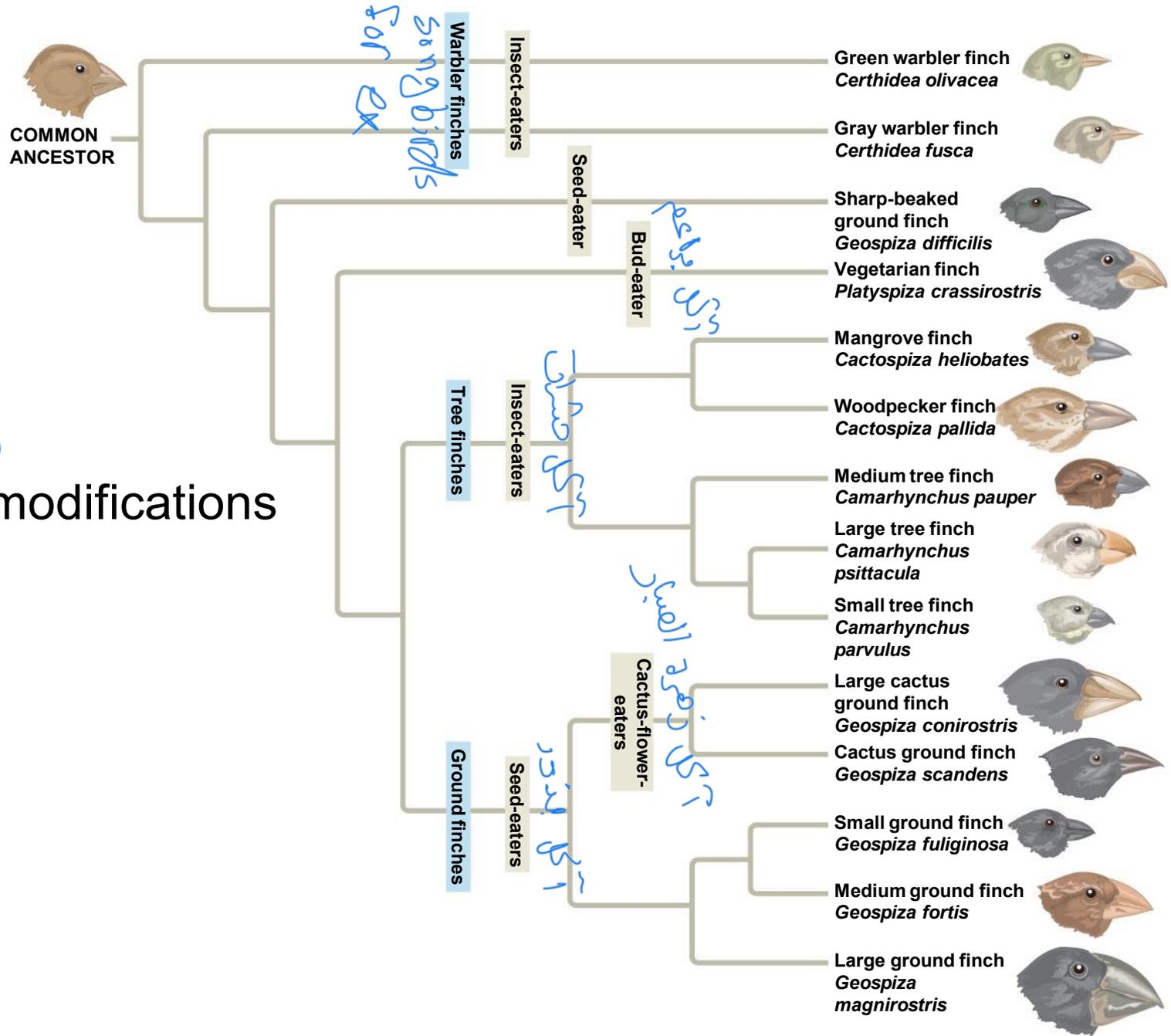


WHALE



BAT

Beak modifications



Scientists use two main forms of inquiry in their study of nature

- The word *Science* is derived from Latin and means “to know”
- *to ask*
Inquiry is the search for information and explanation
- There are two main types of scientific inquiry:
discovery science and **hypothesis-based science**
علوم الاكتشاف *علوم مبنية على فرضيات*

Discovery Science

- **Discovery science** describes natural structures and processes. Like DNA structure and Gravity.
- This approach is based on observation and the analysis of data

تحليل البيانات

ملاحظة

Types of Data

- **Data** are recorded observations or items of information

ملاحظات مسجلة

عناصر

- Data fall into two categories

- **Qualitative**, or descriptions rather than measurements

نوعي

وصف

- **Quantitative**, or recorded measurements, which are sometimes organized into tables and graphs

كمي

قياسات

منظمة في جداول و فقرات

1. In calls behind me. Can't
 see any opposite. Maybe
 2. My wrist - hand behind C. Pad.
 3. S. C. in front. And
 4. finks up & heat & drums
 (tee). No S looked.
 faint. W. in. remains.
 No S - W. P. like?? Hell know.
 1. is starting around my
 hand - on it & me. like
 left hand. Same like
 in white paper.

It is cold & grey, and very
 still. The scene is anticlimax,
 yet full of small moods.
 Bird says - we in the
 distance is a bit like a
 water trough. Boloms - the
 mbs making their 'talking'
 sound. The distant bubbling
 of the creek - always, & as
 a symbol of the African
 land. The 2 figs walk
 sitting comfortably together.
 How ever, 'bear' & 'love'
 my moods.



8:30 No S x 1
 a sound by W. to S. looked.



Hypothesis-Based Science

- Observations can lead us to ask **questions** and **propose hypothetical explanations** called **hypotheses**

الملاحظات

تفسيرات افتراضية

فرضيات

The Role of Hypotheses in Inquiry

إجابة متكررة لشيء محدد

- A **hypothesis** is a tentative answer to a well-framed question

تنبؤات

- A scientific hypothesis leads to predictions that can be tested by observation or experimentation

التجربة و الملاحظة

-
- For example,
 - Observation: Your flashlight doesn't work
 - Question: Why doesn't your flashlight work?
 - Hypothesis 1: The batteries are dead
 - Hypothesis 2: The ^{البطارية}bulb is burnt out
 - Both these hypotheses are testable لا يمكن
التحقق
-



Observations



Question



**Hypothesis #1:
Dead batteries**

**Hypothesis #2:
Burnt-out bulb**

Hypothesis #1:
Dead batteries

① توقع

Prediction:
Replacing batteries
will fix problem

X



Test prediction



Test falsifies hypothesis

Hypothesis #2:
Burnt-out bulb

② توقع

Prediction:
Replacing bulb
will fix problem

✓



Test prediction



Test does not falsify hypothesis

Deduction: The “If...Then” Logic of Hypothesis Based Science

- ^{استنتاجی} **Deductive reasoning** uses general premises to make specific predictions _{معمولاً منطقیہ}
 - For example, **if** organisms are made of cells (premise 1), **and** humans are organisms (premise 2), **then** humans are composed of cells (deductive prediction) _{made of}
-

Theories in Science

- In the context of science, a **theory**^{نظرية} is:
 - Broader in scope^{نطاق} than a hypothesis
 - **General**, and can lead to new testable hypotheses
 - Supported by a **large body of evidence**^{أدلة عديدة أكثر من الفرضية} in comparison to a hypothesis
-

Science, Technology, and Society

- The goal of **science** is to understand natural phenomena
الظواهر الطبيعية
 - The goal of **technology** is to apply scientific knowledge for some specific purpose
تفسير العلم
لغرض الأهدف
 - Science and technology are interdependent
متشابطين
 - Biology is marked by "discoveries," while technology is marked by "inventions"
اكتشافات
اختراعات
-

الدمج (المزيج)

- The combination of science and technology has dramatic effects on society
 - For example, the discovery of DNA by James Watson and Francis Crick allowed for advances in DNA technology such as testing for hereditary diseases
- Ethical issues can arise from new technology, but have as much to do with politics, economics, and cultural values as with science and technology

أمراض وراثية مشاكل أخلاقية

الاقتصاد

السياسة القيم المجتمعية