Fossil Evidence for Evolution 2

Absolute Dating continued: Tree Ring Dating

Relative Dating: Stratigraphy

Date:	Human Biology Year 12 ATAR
Do Now Past Exam Question **Lesson Agenda** 1: Do Now 2: Fossils and Absolute Dating Techniques cont… 3: Lesson Summary and Wind Up **Suggested Study** • Read through today's notes and textbook section • Complete review worksheet, then mark and correct using the answer key on Connect (compulsory). **NEXT LESSON** Relative Dating Techniques – Fluorine dating Geological timescale Phylogenetic tree diagrams	**Learning Aims** • Define dendrochronology and describe how it works • Give an example of where dendrochronology has been used to date an archaeological site. • List limitations of dendrochronology • Define relative dating and compare it to absolute dating • Define stratigraphy and state the main concepts. • Describe the Principle of Superposition • Describe the principle of Correlation of rock strata • Use correlation of rock strata to determine which is the older of two fossils • Define the term "index fossil" and describe what features make an index fossil useful. • Describe the use of fossil pollen grains in stratigraphy **Key Vocabulary** Dendrochronology Stratigraphy Superposition Correlation Index Fossil

Absolute Dating: Tree Ring Dating (Dendrochronology)

Trees grow concentric rings

- Each ring = 1 year growth
- Differ in width according to how good the growing season is (water etc)
- Create a “Timeline” in the tree trunk
- Can match years by comparing one sample to another.
- Can therefore match historically, and count years.

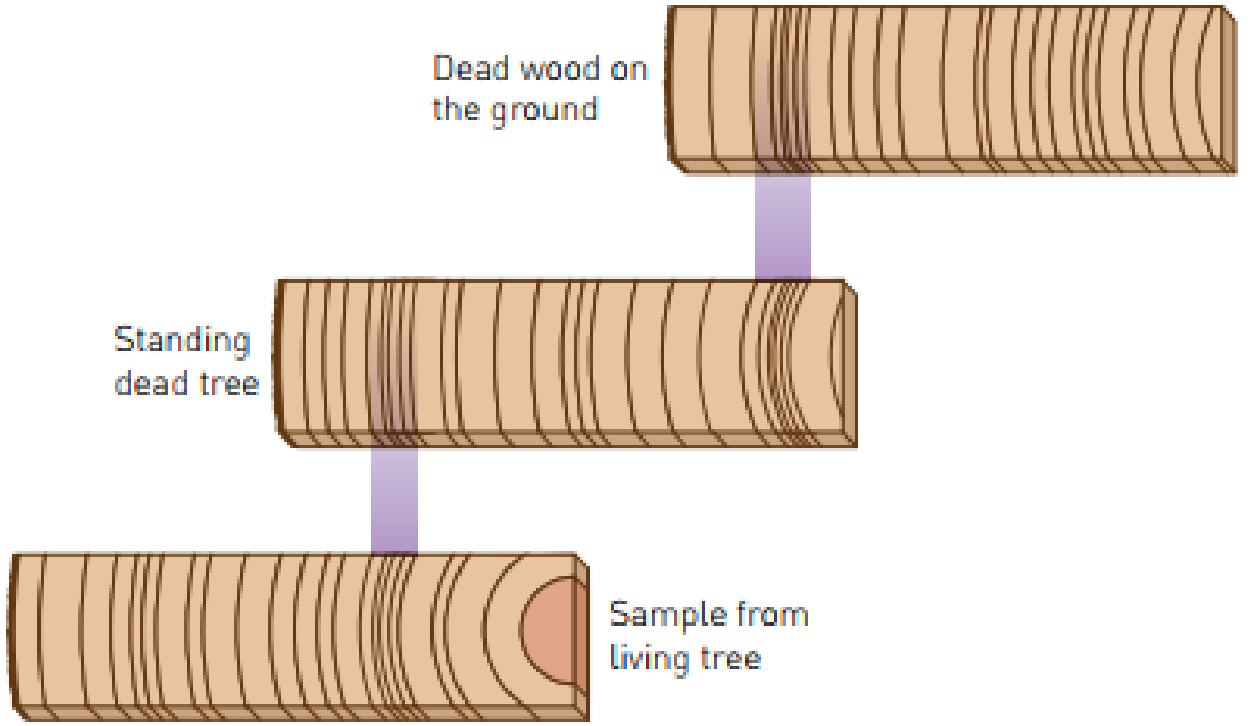


Figure 16.7 Building a tree ring chronology. Overlapped samples from living and dead trees extend the period of dating back to prehistoric times.

Learning Aim: Define dendrochronology and describe how it works.

Absolute Dating: Tree Ring Dating (Dendrochronology)

- Old, living trees are particularly useful for this
  - Bristlecone pine – USA – living trees up to 4500 years old
- Can then look at dead trees, and backtrack using comparison
  - Can date very accurately back to 8600 years ago
  - Can use this to verify accuracy of Carbon-14 dating
- Example: Seahenge
  - Timber circle – coast of England
  - Analysis of central stump using combo of tree-ring and carbon dating
  - Middle stump: tree chopped down in 2049 BC (4000 years ago), and was 167 years old when felled.
- Limitations:
  - Timber only rarely preserved long enough to do long dating
  - Depends on having a continuous succession of nearby timber

Figure 16.8 Seahenge

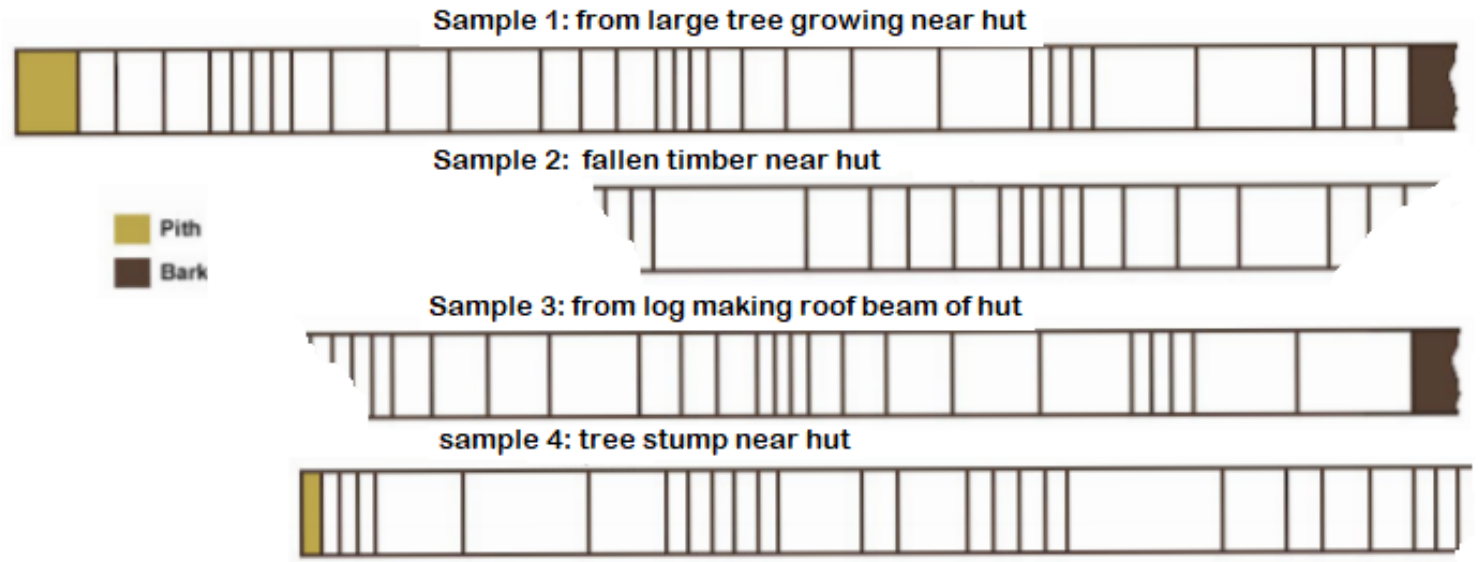
Learning Aim: Give an example of where dendrochronology has been used to date an archeological site. List limitations of dendrochronology.

Dendrochronology Example

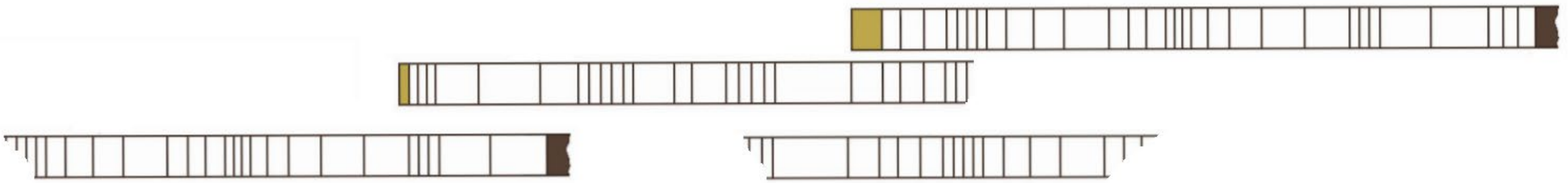
A group of Year 12 students are on a hike in the Perth Hills. As they trudge through the undergrowth, they stumble upon an old wooden hut. They remember the tale that a notorious Perth bank robber, "Robbin' Byrne" hid out in the hills in the mid 1980s and that his hideout has never been found.

They call the police, who send in a forensic investigation squad. The squad take a core sample from a large tree growing near the hut, and from a beam from the roof the hut. They also take a sample of old fallen timber nearby, and of a tree stump near the hut.

Could the hut have been built by "Robbin' Byrne"? Use your dendrochronology skills to find out!



Learning Aim: Model the process of determining age of a sample using dendrochronology.



- Could “Robbin’ Byrne” have built the hut?
- How old is Sample 1?
- When did Sample 4 first start to grow?
- What years are represented in Sample 2?
- What is the earliest year represented by these timber samples?
- Give an example of a year with good rainfall.
- Give an example of a year with poor rainfall.

Learning Aim: Model the process of determining age of a sample using dendrochronology.

Table 16.1 Useful range of common absolute dating methods

Dating method	Material used	Useful range (years BP)
Tree growth rings	wood	up to 9000
Carbon-14	carbon compounds	up to 60 000
Protactinium	sea sediments	up to 250 000
Uranium-thorium	sea sediments, coral	up to 600 000
Potassium-argon	volcanic deposits	200 000 and earlier
Electron spin resonance	calcium carbonate (in shells, coral, teeth), also quartz and flint	up to 100 000, possibly 300 000
Fission tracks	minerals and glass	100 years ago to 4550 million
Thermoluminescence	sediments, lava, ceramics	300 years ago to 100 000

Relative Dating

- Does not give an age. Says whether a sample is older or younger than other samples.
- Enables sequence of events to be established.
- Examples:
  - Stratigraphy
  - Fluorine Dating

(Compare to absolute dating, which gives an age in years before the present day)

Learning Aim: Define relative dating and compare it to absolute dating.

Relative Dating - Stratigraphy

Stratigraphy is the study and comparison of rock layers, or strata, and the fossils they contain, to determine relative age sequence.

3 main concepts:

- Principle of Superposition
- Correlation of Rock Strata
- Index Fossils

- Fossil pollen grain analysis can help confirm other data

Learning Aim: Define stratigraphy and state its main concepts.

Stratigraphy – Principle of Superposition

Principle of Superposition

- In sedimentary rock, layers at top are younger than layers beneath
- Need to be cautious, as distortions of Earth's crust can disturb layers, leading to inaccuracy.

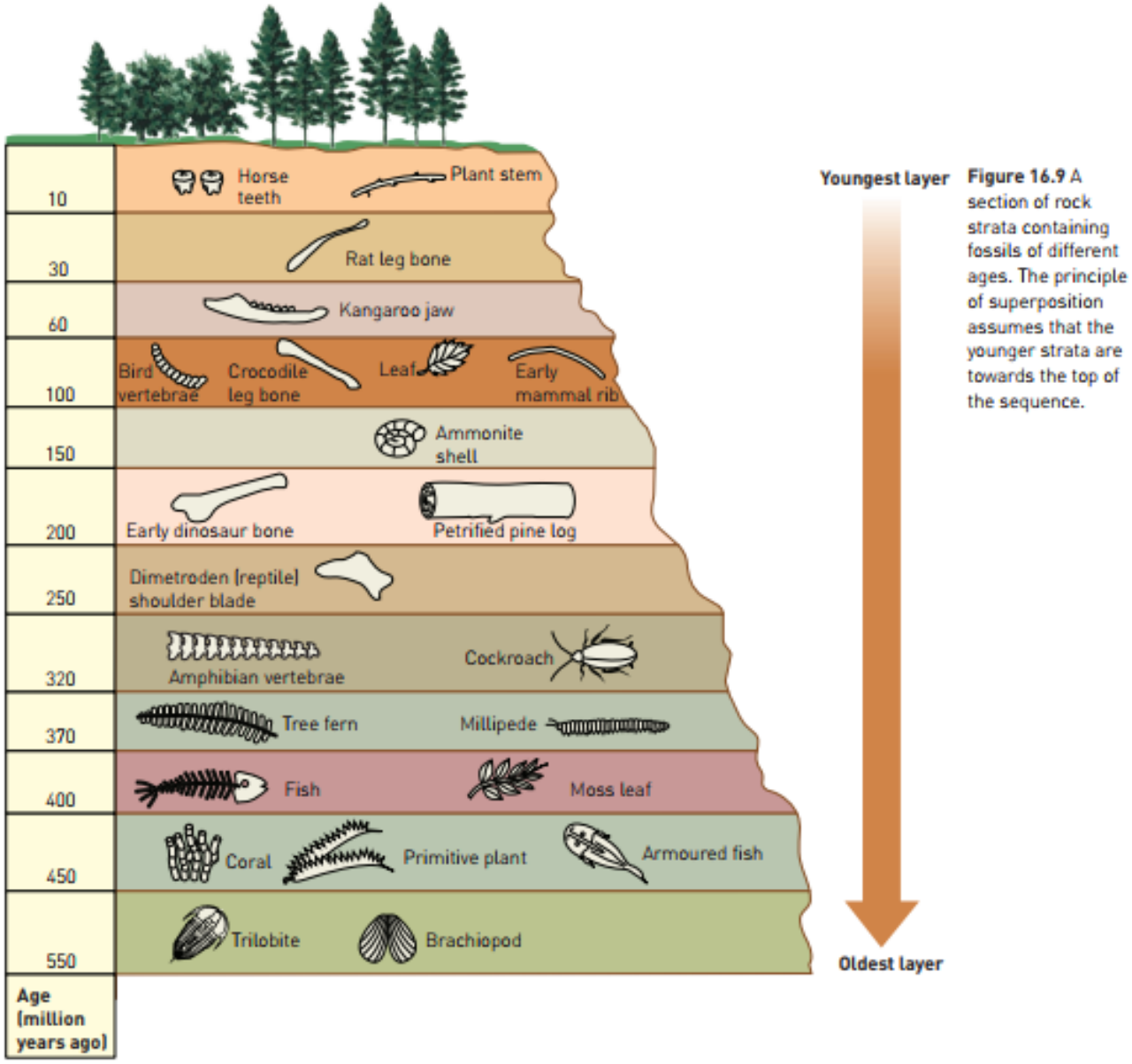


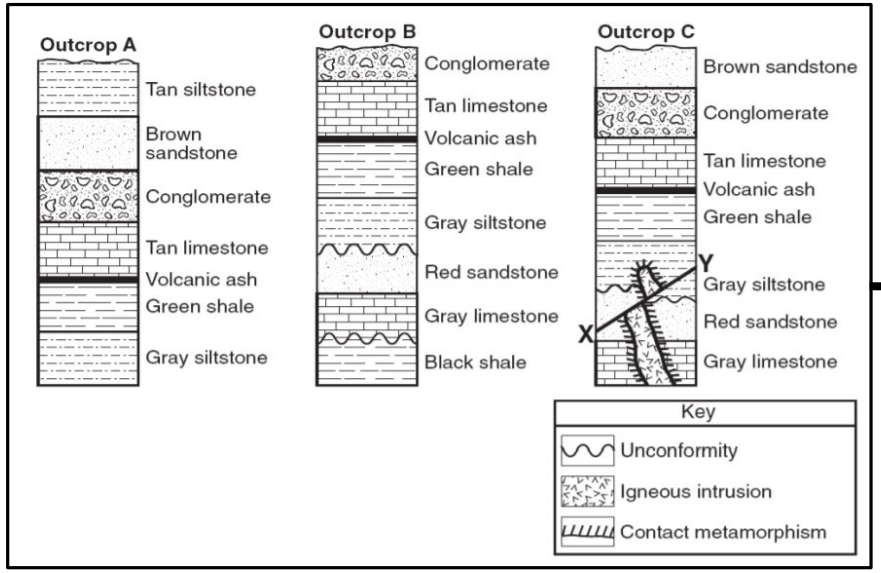
Figure 16.9 A section of rock strata containing fossils of different ages. The principle of superposition assumes that the younger strata are towards the top of the sequence.

Learning Aim: Describe the principle of superposition.

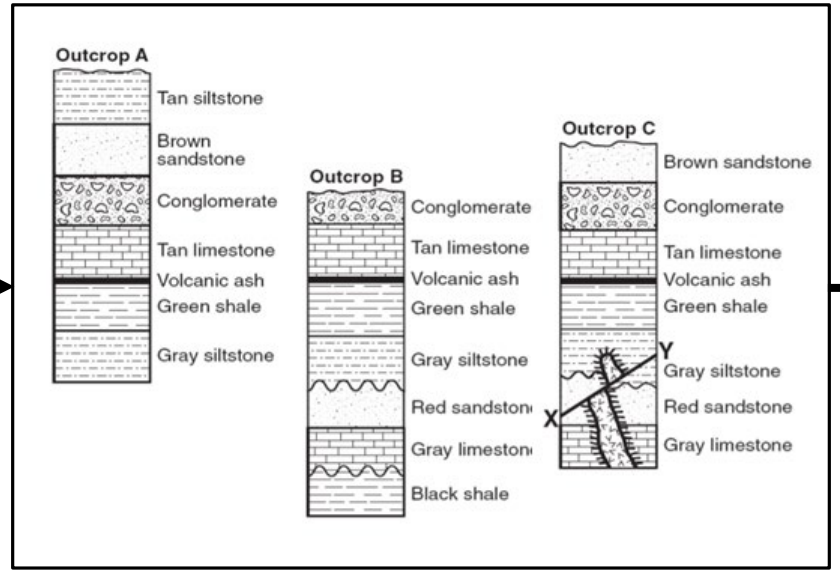
Stratigraphy – Correlation of Rock Strata

Correlation of Rock Strata

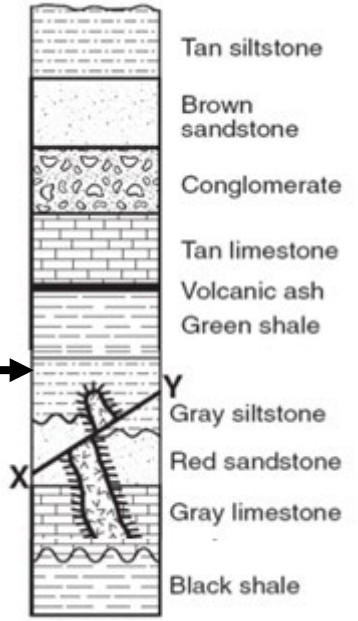
- Matching layers of rock from different areas.
- Examining rock, and also fossils it contains.
- Rocks containing similar fossils are likely to be of similar age.



Rock strata from different areas have similar layer sequences.



We can line up (correlate) those sequences



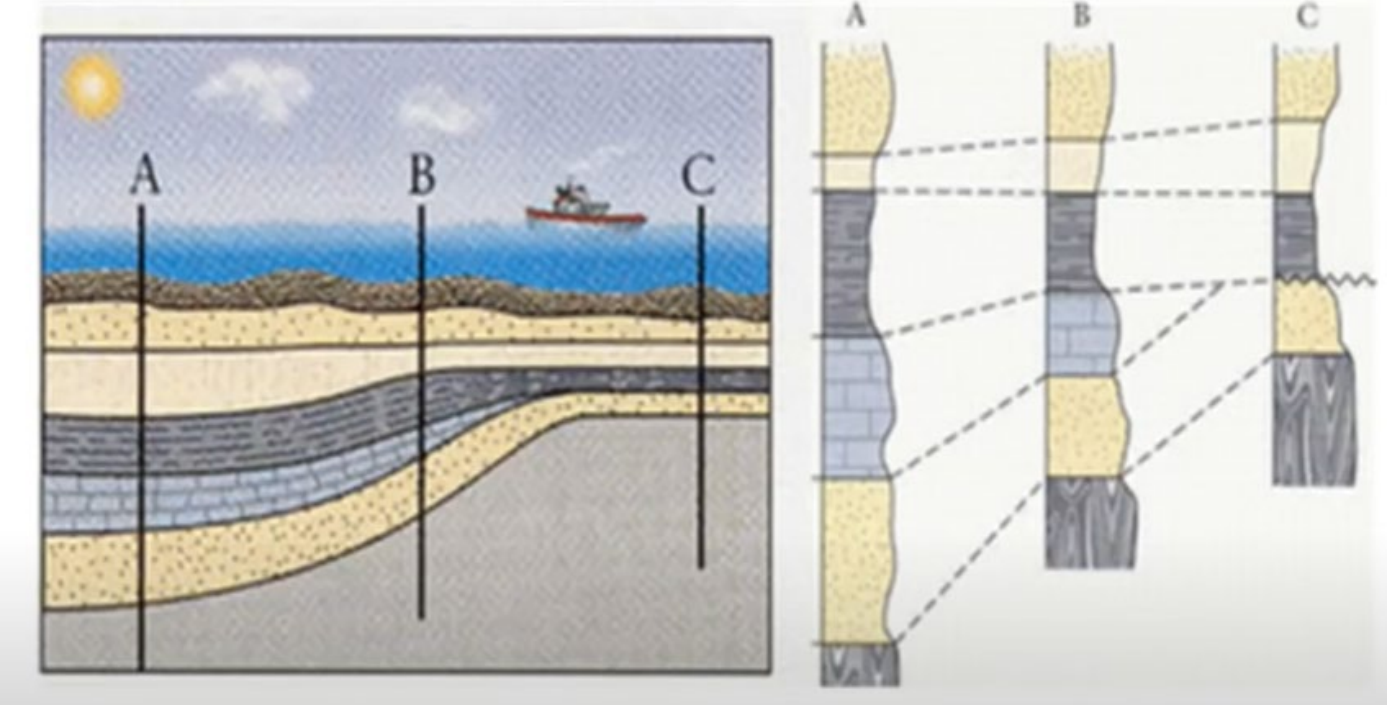
To provide a sequence of layers from oldest to youngest.

Learning Aim: Describe the principle of correlation of rock strata.

Stratigraphy – Correlation of Rock Strata

Correlation of Rock Strata

- Sometimes layers can be missing:
  - Sediments may have eroded and then other sediments may be redeposited
  - One type of sediment may not be as widespread
- We can still correlate using the similar layers:

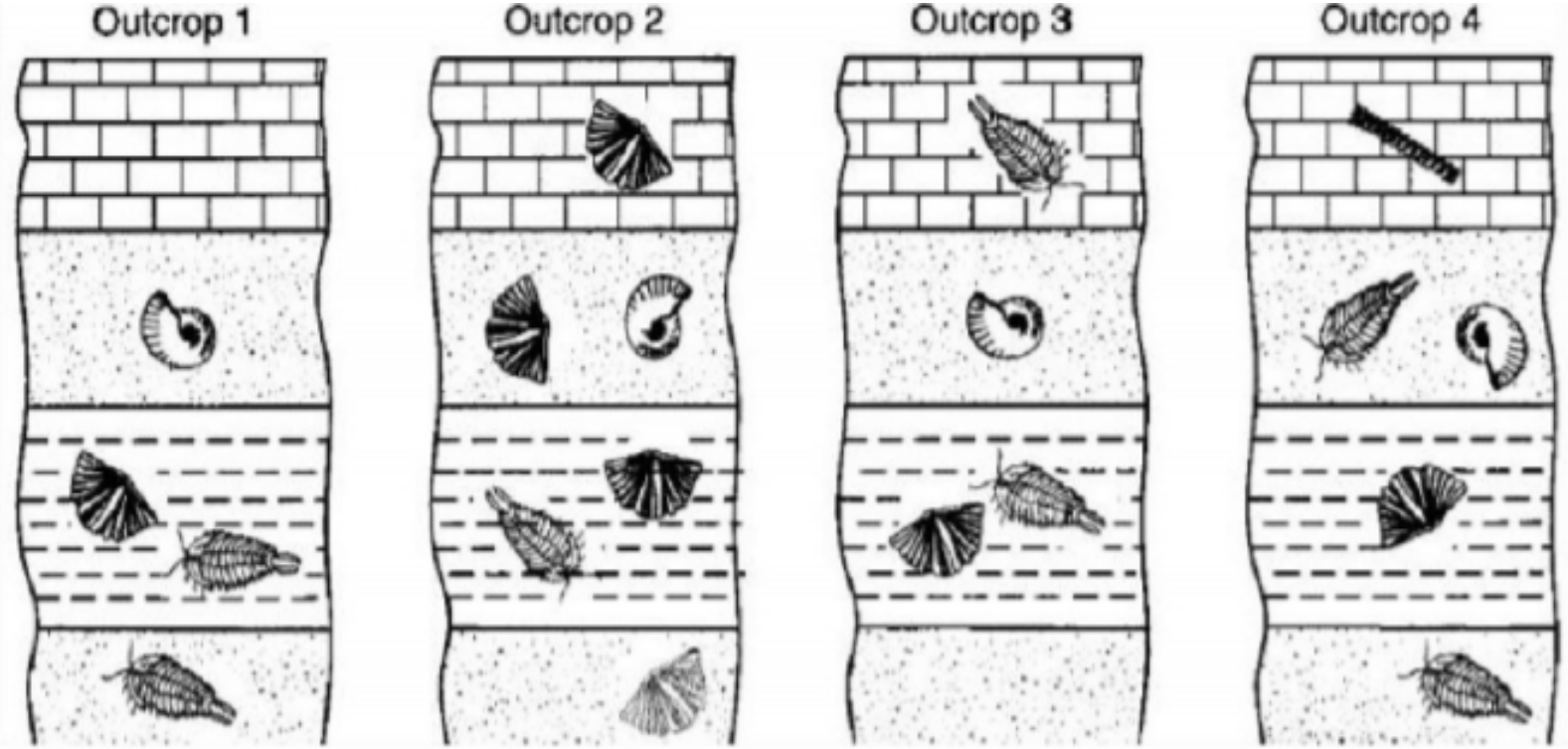


Learning Aim: Describe the principle of correlation of rock strata.

Stratigraphy – Index Fossils

Index fossils:

- **Widely distributed** on earth but only present for a **short historical time**.
- Can be used to correlate strata from different areas of the earth



Which of the fossils shown could be used as an index fossil?

Which organism evolved most recently?

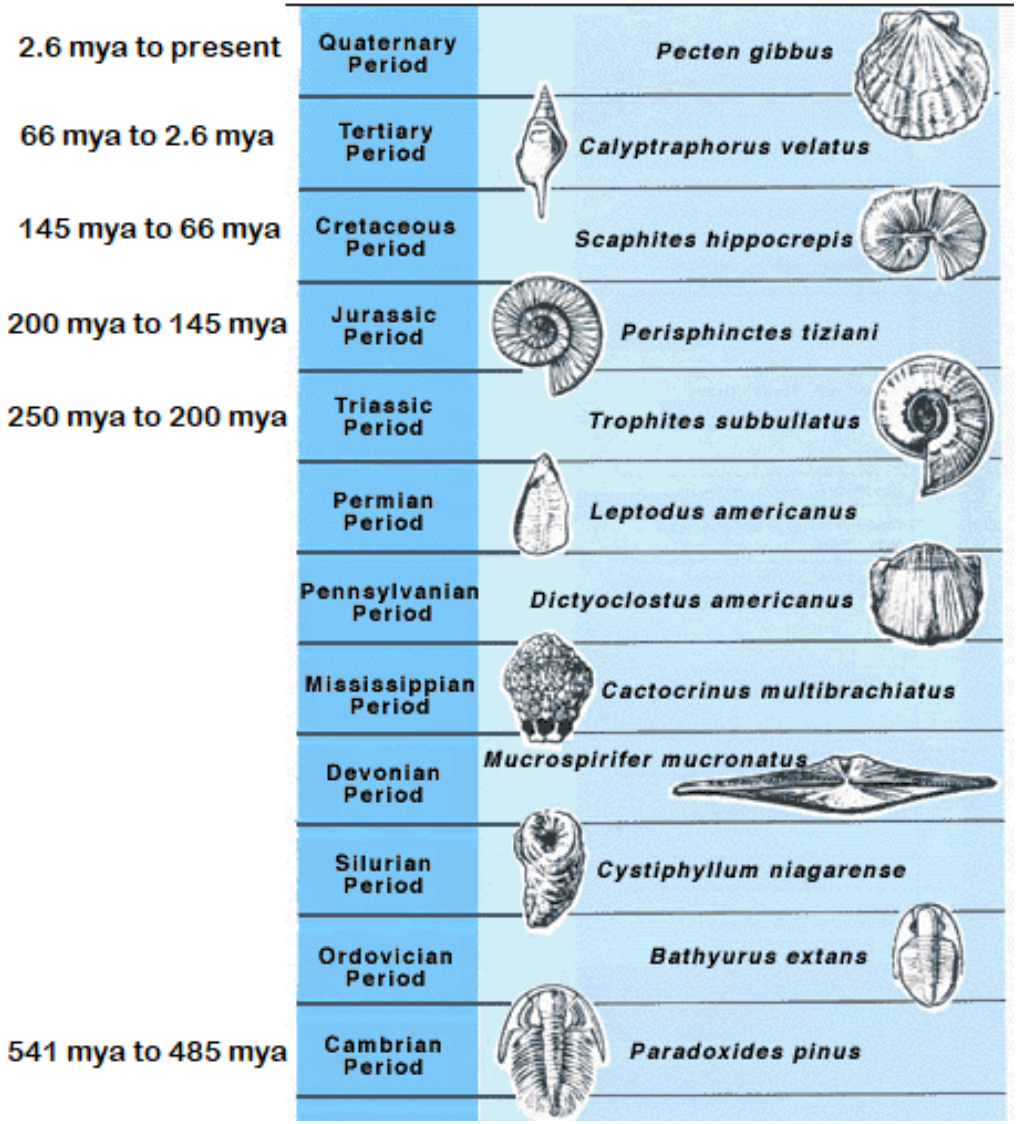
Which organisms existed for the longest period of time?

Learning Aim: Use correlation of rock strata to determine which is the older of two fossils.

Learning Aim: Define the term index fossil and identify features that make an index fossil useful.

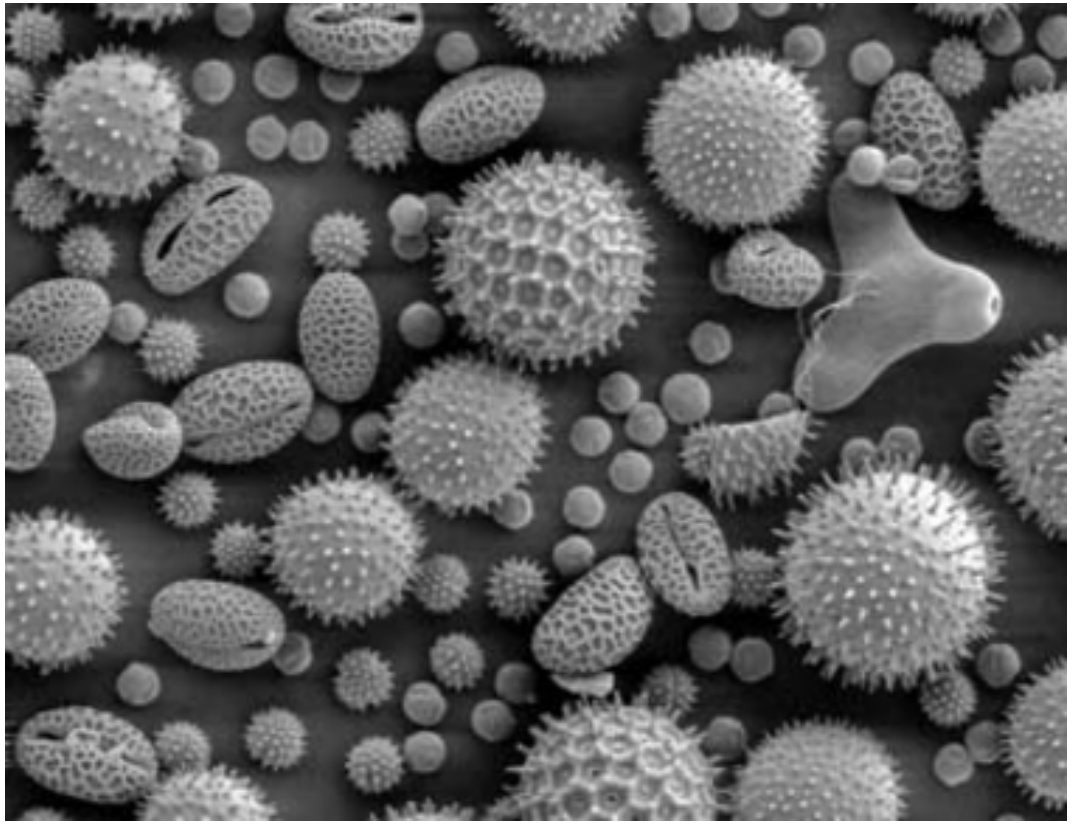
Stratigraphy – Index Fossils

Some examples of index fossils used to determine age of rock layers:



Stratigraphy – Fossil Pollen Grain Analysis

- Pollen is produced by flowering plants and is unique to each species of plant.
- Can be seen under a microscope.
- Fossil pollen grains:
  - Some useful as Index Fossils (if plant was widespread but only around for a short time period)
  - Can be used to get a picture of type and amount of vegetation present at the time the fossils formed.
  - Can be used to infer information about climate.
  - Can then be used to confirm relative dates



Learning Aim: Describe the use of fossil pollen grains in stratigraphy.