NATURAL HISTORY MUSEUM

Human Evolution: Analysing the Evidence

Please use this information to help you and your students get the most from your visit.

Your workshop	
Workshop name	Human Evolution: Analysing the Evidence
Start time	10.30 12.30
Duration	1 hour 15 minutes
Recommended ratio	1 adult : 10 students
Minimum ratio	1 adult : 10 students
Maximum group size	30 students
Please ensure you meet the required minimum adult to student ratio	

Real World Science

About the workshop

Human Evolution: Analysing the Evidence is a hands-on workshop that challenges KS4 students to explore the evolutionary relationships between present-day and ancient humans, collectively known as hominins. To do this they will use some of the techniques employed by scientists studying human evolution, for example observation-based comparative anatomy and quantitative comparisons using cranial measurements.

It gives students the opportunity to engage with this rapidly changing and sometimes controversial field of research, exemplifying work of scientists from the Natural History Museum's Human Origins Project.

Students recap their knowledge of evolution and learn about comparative anatomy by comparing present-day human, mammal and reptile skulls. They explore the concepts of relatedness and common ancestry by observing and collecting evidence of similarities and differences. They then work in groups and use the techniques they have learnt to investigate casts of fossil hominin skulls and make predictions of relatedness between them.

After discussing the limitations of purely qualitative comparative anatomy, students learn how to take cranial measurements and work in groups to collect data that will enable them to compare the properties of the skulls graphically and draw evidence-based conclusions. Examples of the work of Professor Chris Stringer, leader of the Museum's Human Origins Project team, are given so students can see that the skills they are using in the workshop are those employed by scientists. As part of the data collection, students will consider the reliability of data and discuss the potential for error.

Students will find out what the data they have collected suggests about the relationship between these human species and how these findings have informed one of the current theories explaining the origin of our species.

Finally, they will discover more about the human species represented by the skulls, and work in groups to prepare a short presentation on their findings.

Intended learning outcomes

Knowledge and understanding

- Observed similarities and differences can be used to classify organisms and infer common ancestry, and an evolutionary tree diagram can be used to express these relationships.
- Fossils are one of the primary sources of evidence in the field of human evolution.
- It is important to work accurately, safely and carefully when collecting scientific data.
- It is necessary to use a number of different techniques to identify hominin species and their place in the evolutionary pathway of humans.
- Scientific careers and what working as a scientist can involve.
- Scientific research can produce uncertainty and that scientific ideas can change over time as new evidence is discovered.
- Timescales over which hominin evolution has occurred, and that it is not a linear process.

Skills

- Communication skills in questioning, discussing and presenting scientific ideas using scientific language.
- Observational skills to identify similar and different features of skulls of different animals and hominin skulls.
- Practical and problem-solving skills to collect and interpret data.

Attitudes and values

- Feel confident and comfortable discussing a fast-changing scientific field that is highly uncertain and within which there are few straightforward answers.
- To value museums and universities as centres of scientific research with real world applications.

Enjoyment, creativity and inspiration

- Experience awe and wonder about the natural world through close access to museum specimens.
- Fun, empowering learning through teamwork and hands-on activity.

Examination board GCSE syllabus links

Edexcel Biology

How Science Works
Data, evidence, theories and explanations

1. The collection and analysis of scientific data.
2. The interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories.
4. There are some questions that science cannot currently answer and some that science cannot address.

Practical and enquiry skills

6. Collecting data from primary or secondary sources, including the use of ICT sources and tools.
7. Working accurately and safely, individually and with others, when collecting first-hand data.
8. Evaluating methods of data collection and considering their validity and reliability as evidence.

Communication skills

9. Recalling, analysing, interpreting, applying and questioning scientific information or ideas.
11. Presenting information, developing an argument and drawing a conclusion, and using scientific, technical and mathematical language, conventions and symbols and ICT tools.

Applications and implications of science

14. How uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.

Unit B2 – Topic 3 – Common systems

3.1 Evaluate the evidence for evolution based on the fossil record.
3.2 Explain why there are gaps in the fossil record, including:
c because many fossils are yet to be found.

Unit B3 – Topic 2 – Behaviour

2.14 Describe the evidence for human evolution, based on fossils, including:
b Lucy from 3.2 million years ago.

AQA GCSE Biology

3.2 How Science Works
Fundamental ideas

- It is necessary to distinguish between opinion based on valid, repeatable and reproducible evidence and opinion based on non-scientific ideas (prejudices, whim or hearsay)
- Evidence must be looked at carefully to make sure that it is:

– Repeatable

– Reproducible

– Valid

When making measurements we must consider such issues as inherent variation due to variables that have not been controlled, human error and the characteristics of the instruments used. Evidence should be evaluated with the repeatability and validity of the measurements that have been made in mind.

- There will always be some variation in the actual value of a variable, no matter how hard we try to repeat an event.
- Even when an instrument is used correctly, human error may occur; this could produce random differences in repeated readings or a systematic shift from the true value.

Presenting data

- Scattergrams can be used to show an association between two variables.

Evaluation

- In evaluating a whole investigation the repeatability, reproducibility and validity of the data obtained must be considered.

Societal aspects of scientific evidence

- The status of the experimenter may influence the weight placed on evidence; for instance, academic or professional status, experience and authority.

Limitations of scientific evidence

- There are some questions that science cannot answer directly. These tend to be questions where beliefs, opinions and ethics are important.

B1.8 Evolution

Candidates should use their skills, knowledge and understanding to:
- Interpret evidence relating to evolutionary theory.

B1.8.1 Evolution

d Studying the similarities and differences between organisms allows us to classify living organisms into animals, plants and micro-organisms, and helps us to understand evolutionary and ecological relationships. Models allow us to suggest relationships between organisms.

B2.8.1 Old and new species

a Evidence for early forms of life comes from fossils.
d We can learn from fossils how much or how little different organisms have changed as life developed on Earth.

OCR Twenty First Century Science GCSE Biology A

1 Data: their importance and limitations

1.1 Data are crucial to science. The search for explanations starts from data; and data are collected to test proposed explanations.
1.2 We can never be sure that a measurement tells us the true value of the quantity being measured.

3 Developing scientific explanations

3.2 An explanation cannot simply be deduced from data, but has to be thought up creatively to account for the data.

4 The scientific community

4.3 If explanations cannot be deduced from the available data, two (or more) scientists may legitimately draw different conclusions about the same data. A scientist's personal background, experience or interests may influence his/her judgement.
4.4 An accepted scientific explanation is rarely abandoned just because some new data disagree with its predictions. It usually survives until a better explanation is available.

6 Making decisions about science and technology

6.4 Some questions, such as those involving values, cannot be answered by science.
6.5 Some forms of scientific research, and some applications of scientific knowledge, have ethical implications. People may disagree about what should be done (or permitted).

3.4.3 Module B3: Life on Earth

B3.2 How has life on Earth evolved?

10. Understand that evidence for evolution is provided by the fossil record and from analysis of similarities and differences in the DNA of organisms.

B3.3 What is the importance of biodiversity?

3. Understand that the classification of living and fossil organisms can help to:

b show the evolutionary relationships between organisms.

B6.4 How do humans develop more complex behaviour?

1. Understand that the evolution of a larger brain gave early humans a better chance of survival.

9.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

Moral issues

The commitment of scientists to publish their findings and subject their ideas to testing by others.

B3 Study of scientists' reactions to competing explanations to account for evidence relating to evolution of life on Earth.

OCR Gateway Science GCSE Biology B

3.3 Fundamental Scientific Processes

How Science Works

- Recall that scientific explanations (hypotheses) are:
- used to explain observations
- tested by collecting data/evidence
- Describe examples of how scientists use a scientific idea to explain experimental observations or results.
- Recognise that scientific explanations are provisional but more convincing when there is more evidence to support them.
- Describe (without comparing) the scientific evidence that supports or refutes opposing scientific explanations. (Higher tier – Evaluate and critically compare opposing views, justifying why one scientific explanation is preferred to another.)
- Explain how a scientific idea has changed as new evidence has been found. (Higher tier – Identify the stages in the development of a scientific theory in terms of the way the evidence base has developed over time alongside the development of new ways of interpreting this evidence.
- Recognise that scientific explanations are provisional because they only explain the current evidence and that some evidence/observations cannot yet be explained. (Higher tier – Recognise that confidence increases in provisional scientific explanations if observations match predictions, but this does not prove the explanation is correct.

Module B2: Understanding Our Environment

Item B2f: Natural selection

Foundation tier:

- Recognise that over long periods of time, groups of organisms can change and that this is called evolution.
- Understand how when environments change, some animal and plant species survive or evolve but many become extinct.

Higher tier only:

- Explain how over long periods of time the changes brought about by natural selection may result in the formation of new species.

Evaluation of the workshop

To continually assess the effectiveness of the workshop, we would be grateful if you and your students could complete feedback forms at the end.

After the workshop

Gallery-linked activity

Students can explore how life on Earth evolved over millions of years by visiting our galleries.

Explore and Discover guides

You can complement Human Evolution: Analysing the Evidence with one of our Explore and Discover guides. These guides are linked to specific galleries and have content that may be suitable for the topics your students are studying at school.

Key Stage 4: Evolution on Earth

Please see the full Explore and Discover secondary series at www.nhm.ac.uk/education/school-activities/self-led-activities/explore-discover-guides/explore-secondary/index.html

These guides cost 50p each, which is payable before the day of your visit.

For more information, please contact our Bookings team on 020 7942 5555.

Exhibitions

Between February and August 2014 we also recommend a visit to the temporary exhibition Britain: One Million Years of the Human Story, which provides access to objects, reconstructions and case studies that show how the analytical techniques used in the workshop shaped the theory of how the population of Britain evolved.

An activity guide for secondary students is available for the exhibition.

For more information about temporary exhibition entry prices for school groups, please contact our Bookings team on 020 7942 5555.

Health and safety

This workshop uses a range of objects and equipment to ensure students meet the intended learning outcomes of the session. Please ask students to wash their hands immediately after the session and before consuming any food.

A note about behaviour

Teachers have overall responsibility for the behaviour of their pupils and we expect you to support Museum staff with this where necessary. Pupils benefit significantly when teachers and accompanying adults also get involved in practical workshops and share their own expertise, so please do join in where appropriate, even if this is not your subject specialism.