

# LENScience Senior Biology Seminar Series

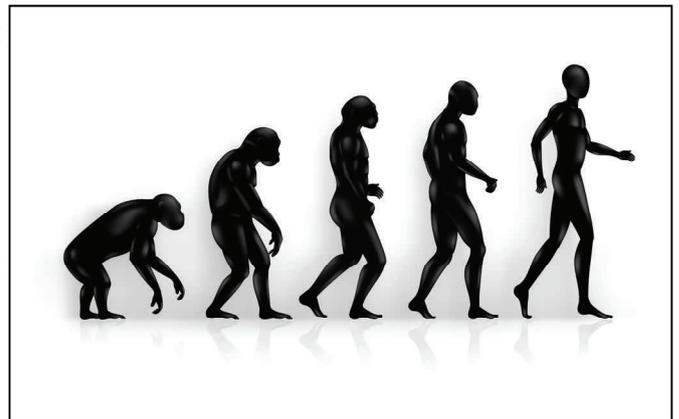
## The Evolving Brain: social interaction and complexity

### Questions and Discussion

#### Pre-seminar school discussion

During Year 12 you started to explore patterns and process of evolution. You will continue to learn more about these processes this year, including looking at how they relate to human evolution. Human evolution is based on these same underpinning processes and patterns. Evidence for and understanding of human evolution has itself evolved during recent history, with the advent of molecular technologies contributing to this field.

The evolutionary success of humans and their direct ancestors can be linked to selection that led to the development of intelligence. Multiple inter-related factors have led to the development of intelligence in humans and the success that has accompanied this for the species. Key to understanding evolution is the concept that **collectively adaptive advantage must outweigh adaptive cost** for the evolutionary success of a species. This seminar explores factors that have led to the evolutionary success of the human species.



#### Pre-seminar review questions:

1. Humans are members of the *Hominin* group which is a subset of the *Hominoid* group. What are the key factors that define *Hominins* within the *Hominoids*, and what is the relationship between these groups and the primates.
2. **Natural selection** is a term that is used extensively in discussion of evolution. Define what this term means and discuss factors that contribute to selection.
3. What is meant by **FITNESS** in evolutionary terms. Explain the relationship between evolutionary fitness, adaptation and selection.
4. **Adaptive radiation** can be observed in multiple groups of living organisms. The mammals and primates are among these groups. Define what is meant by ADAPTIVE RADIATION and use examples to discuss factors that lead to adaptive radiation.

## Level 3 Achievement Standards linking to this seminar:

AS 90717 Biology 3.5 Describe processes and patterns of evolution  
AS 90719 Biology 3.7 Describe trends in human evolution

## Key Concepts from Level 3 Biology that link to this seminar:

Below are selected objectives from the Y13 biology programme that link to this seminar. THESE ARE NOT A FULL LIST OF THE CONCEPTS IN YOUR COURSE. You should review these concepts before the seminar.

### Processes and Patterns of Evolution

*Remember these are only the objectives linking to this seminar—refer to your unit hand out at school for a full list. A number of the objectives listed here come from the Y12 Biology programme. Understanding of relevant core concepts from the Y12 programme underpin the development of concepts in the Y13 programme.*

- Define the term species and ways in which speciation occurs
- Define gene and allele frequency, speciation, gene flow, genetic equilibrium.
- Identify sources of genetic variation and agents of change that lead to change in a gene pool.
- Define the terms genetic drift, founder effect and bottleneck effect.
- Explain the role of natural selection in speciation
- Describe patterns of evolution: convergent, divergent (incl. adaptive radiation), co-evolution, and the speed of evolutionary change i.e. punctuated equilibrium, gradualism.

### Trends in Human Evolution

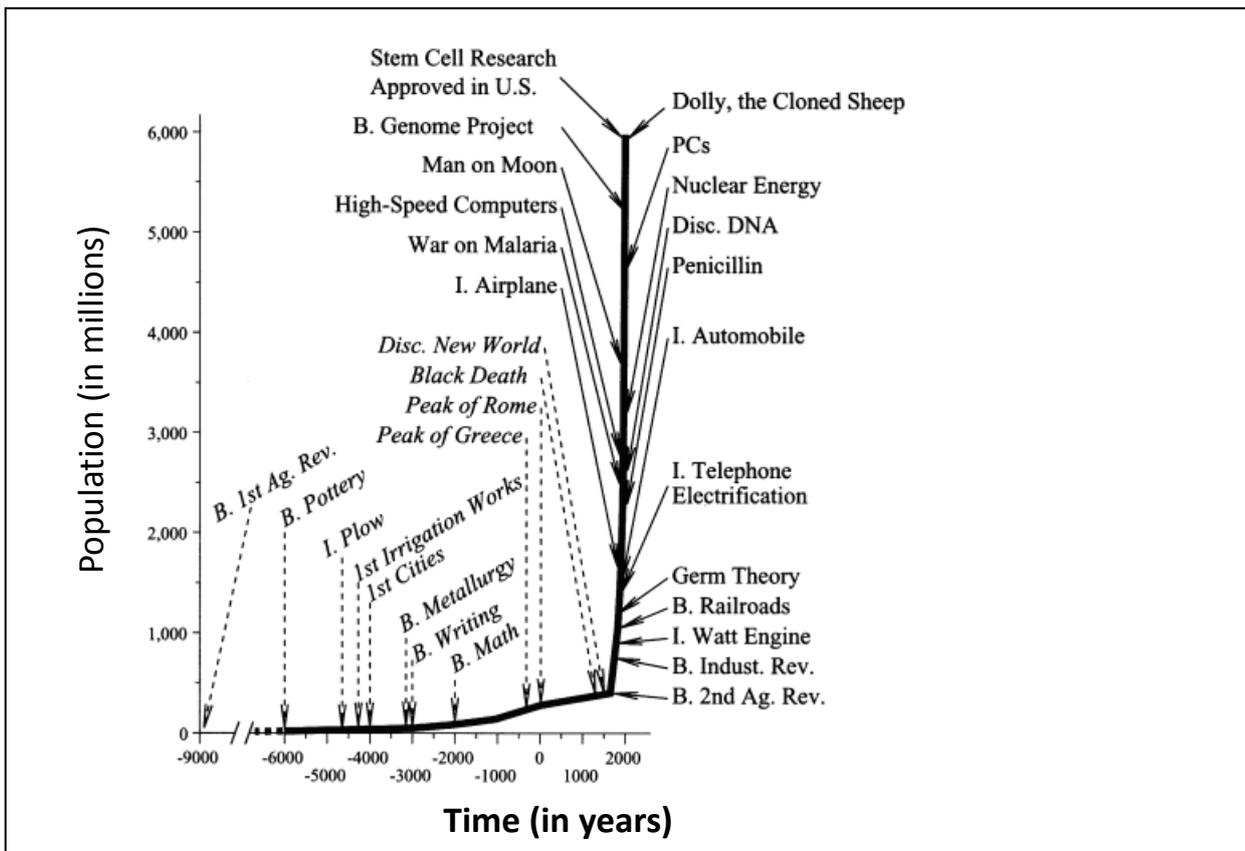
*Please remember these are only the objectives linking to this seminar—refer to your unit hand out at school for a full list.*

- Define the hominin lineage and describe the characteristics of major species in that lineage
- Describe trends in biological evolution of the hominins with respect to:
  - skeletal changes linked to bipedalism
  - changes in skull and endocranial features
  - changes in manipulative ability of the hand
- Describe trends in cultural evolution of the hominins with respect to use of tools, fire, shelter, clothing, abstract thought (communication, language, art), food-gathering, and domestication of plants and animals.
- Describe patterns of dispersal of hominins (multiregional and replacement hypotheses) and the evidence supporting these hypotheses.
- Describe recent developments in interpretations on the origins and trends of human evolution based on current scientific evidence which is widely accepted and presented in peer-reviewed scientific journals.

## Post Seminar Challenge Questions

1. Human evolution can be characterised by both biological and cultural change over time. Compare and contrast biological and cultural evolution in terms of transmittance of information between generations, selection, and fitness.
2. The evolutionary origins of brain expansion are believed to be linked to the adaptive advantage of social interactions within a group. Anthropologist Robin Dunbar from the University of Oxford has suggested that living in larger groups offered evolutionary advantage to our ancestors (page 6 student reading).
  - (a) Discuss the role of living in groups in the evolution of humans and our ancestors.
  - (b) Dunbar suggests that humans have evolved to live effectively in groups of approximately 150 individuals. Discuss the potential benefits and challenges that are offered to modern humans by the technological advances in communication and travel, and consider the potential effect of these on the success of human populations.
3. The human population has risen exponentially over the past 2000 years. Fogel (see figure below) suggests that there is a link between human population growth rates and cultural evolution. The figure indicates that the point at which the rate of population growth changed dramatically coincides with the beginning of the second agricultural revolution.

Discuss how population growth rates in humans have changed in the past 2000 years, outlining your view on the potential reasons for this change in rate.



The growth of the human population and major technological developments.

From Fogel, R 2004 *The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the Third World* Cambridge University Press