Homology and analogy essay: animal form and function essay sample

Science, Genetics

Similarities of physiology and behaviour due to homology – share common ancestor with that trait or analogy – not due to common ancestor but common due to convergent evoution.

Improvement suggestions: the behavioural homology of crocodiles and birds may be flawed. Also the analogy between fish and mammals could be wrong as the post-anal tail of quadrupedal mammals and fish is a common trait.

Homology and Analogy Essay

Animal Form and Function

Homology and Analogy

Many species share similarities in their structural apperance and behaviour but this can be due to different reasons. A characteristic or behaviour is said to be homologous if it is shared by two or more species and was present in their common ancestor. Homologous features arise from adaptive radiation whereby many species derive from a single or few ancestor species to adapt to different environmental conditions and modes of life. By descent with modification species adapt to new environments by modifying existing charcteristics. Homologous structures are often specialized in different organisms, for example the pentadactyl limbs of tetrapods contain the same basic structure but the bones have been adapted to each organisms way of life.

This is demonstrated by the elongated digits of bats to support their wings, and the the grasping hand of a monkey adapted for climbing. Charateristics

or behaviours that are similar in two or more species but not present in their common ancestor are said to be analogous. Analogous features arise through convergent evolution as they have developed separatley in unrelated taxonomic groups as a result of a similar way of life, for example the wings of birds and insects as they do not share a common ancestor with wings. The theory of evolution suggests we would expect a higher number of shared homolgies for closely related species, and decreasing number as the species become less related (Campbell & Reece, 2005; Purves et al., 2001;

http://people. westminstercollege. edu/faculty/jrogers/II%20homology. ppt).

Examples of Morphological Analogy and Homology

Fish and Mammals

An example of homology between fish and mammals is the presence of a jaw, providing the ability to bite and chew, which assist in food capture and aid digestion. The Humpback anglerfish, and the Lion both possess specialised jaws, both groups are descended from a common ancestor that had a jaw, and so this trait is described as homologous (Purves et al. 2001;

http://io. uwinnipeg. ca/~simmons/16cm05/1116/chordate. html, http://cal. man. ac. uk/student_projects/2003/mnzo0mlk/lecture5. html).

An example of analogy between fish and mammals is the presence of a flattened tail for propulsion in water. The tails are described as analogous as the whales have evolved from terrestrial quadrupedal mammals and adapted their tails from the hindlimbs of their ancestors. The hind limbs were

gradually lost as their skeletons adapted back to life in water. As the evidence suggests whales have evolved from land animals this explains why in mammals such as the Orca the tail flukes are horizontal and move ventrally (up and down), and in fish for example Black Sea Bass, the caudal fin (tail) is vertical and moves laterally (from side to side). The tails are structurally different but have the same fuction of propulsion and so are analogous (de Sarre, 1994; http://evolution. berkeley. edu/evolibrary/article/0_0_0/lines_04).

Insects and Birds

A homologous feature of birds and insects is that they both possess circulatory systems. As animals evolved from small unicellular organisms into larger multicellular organisms diffusion between the cells and environment alone was not enough to provide nutrients to all the cells in the body, and so animals had to develop circulatory systems to move nutrients, hormones and metabolic wastes around the body. In insects, e. g. Large Marsh Grasshopper, this is an open ciculatory system where the blood or haemolymph bathes all the internal tissues and organs. Insects do not transport oxygen via their circulatory system but have a separate tracheal system to supply oxygen to the cells. In birds, e. g. Bee Hummingbird a closed circulation system transports the blood around the body via arteries, capillaries and veins by the pumping action of the heart. The first animals with circulatory systems probably had a simple open-circualtion which later developed into a more specialised closed-circulation system, and so although the systems are different in structure and the way they achieve circulation,

they have evolved from the same original system (Campbell & Reece, 2005; Purves et al., 2001).

The wings of birds e. g. Bald Eagle and insects such as the Green Darner Dragonfly are analogous as they are both used for flight but have evolved separately and the two groups do not share a common ancestor with wings or a structure that gave rise to both types of wing. The structure of insect wings which are extensions of the body wall, differs greatly from that of bird wings which are modified skeletal forelimbs. The support for insect wings are veins whereas for birds the support structures are the bones. Although insects and birds share a remote common ancestor, the wings of the two groups evolved separatley after their ancestral groups had split (Purves et al., 2001; http://www. cals. ncsu. edu/course/ent425/tutorial/circulatory. html

http://www. factmonster. com/ce6/sci/A0803864. html).

Birds and Mammals

The pentadactyl limb is a homologous trait of birds and mammals. The bones in the wings of a bird e. g. Great Tit, and the bones in the legs of a mammal e. g. Arctic Wolf are derived from the common tetrapod (four-legged) ancestor, although during the course of evolution these structures have been modified greatly to adapt to their different habitats and way of life. The limbs both retain the five digit structure at some stage in their development (birds lose two of these during development). In the bird the digits support their wings and in wolves the digits are shortened to allow fast running. As there is no functional or environmental reason why these limbs should all have five

digits, however, these bones are seen in transitional fossils of the extinct Eusthenopteron, which lived about 350 million years ago. Birds and mammals both inherited their pentadactyl limb from this common ancestor (Purves et al., 2001;

http://people. westminstercollege. edu/faculty/jrogers/II%20homology. ppt; http://www. zoology. ubc. ca/~bio336/Bio336/Lectures/Lecture5/Overheads. html).

Feathers and fur, which are both used for insulation by endotherms but differ in their origins are an analogous trait of birds e. g. Spotted Owl, and mammals e. g. House Mouse. As the Aves and Mammalia groups are quite evolutionarily distant these features are analogous – have similar function due to similar environmental pressures

(http://courses. washington. edu/chordate/453lectures/453-intro-06. htm).

Macropod Marsupials and Lagomorphs

The Macropod Marsupials e. g. Tammar Wallaby and Lagomorphs, e. g. Eastern Cottontail rabbit are both of the class Mammalia and so share many homologous characteristics such as the presence of fur for insulation. Some of the earliest mammals had fur or hair and this successful adaptive trait was passed to their many descendants. As both groups share a common ancestor with fur, fur can be said to be homologous between the two groups.

An example of analogy between Macropod marsupials such as the Red Kangaroo and Lagomorpha such as the Antelope Jackrabbit is that both

groups possess large, powerful hind limbs. These are both used for speed and manoeuvrability and therefore have a similar function. However, Macropod marsupials are Marsupialia and Lagomorpha are Eutherians also known as placental mammals, marsupial and placental mammals are very different, and diverged from each other a long time ago on the evolutionary tree. They are therefore unlikely to have a common ancestor with this trait. Instead the trait has arisen through convergent evolution, due to the similar environmental selection pressures on the separate groups

(http://en. wikipedia. org, http://evolution. berkeley. edu/evolibrary/article/0_0_0/similarity_hs_07).

Primates and Xenarthrans

Primates e. g. the Pied Tamarin and Xenarthrans such as the Giant Anteater, are both Vertebrates and so both have a spinal column, enclosed in and protected by the vertebral column. They inherited this feature from a common ancestral vertebrate of the pre-Cambrian era. The spinal cords of the two groups are therefore a homologous morphological trait as the groups share a common ancestor with this trait (http://www. netipedia. com/index. php/Spinal_column; http://io. uwinnipeg. ca/~simmons/16cm05/1116/chordate. htm).

Primates such as the Orangutan and Xenarthrans such as the Maned Three-toed Sloth both have elongated front limbs and specialised hands and feet adapted for their life in the trees. Primates have adapted fingers and opposable thumbs to aid gripping and climbing, this is important as infants

cling to the fur of their mother and must have strong front limbs. Sloth’s have claws instead of fingers to aid hanging and swinging, and infants also hang to the mothers’ fur so strong limbs are needed. The claws and fingers provide same function but are structurally different. This feature is analogous as the two groups do not share a common ancestor with it, but have evolved them separately, through convergent evolution, due to similar environmental conditions

(http://www. netipedia. com/index. php/Sloth).

Behavioural traits

Homology and analogy can also be seen in behavioural traits. Behavioural homology can be described as the similarity of behaviour between two or more species due to a common ancestor with that behaviour. For example the nesting behaviour of birds such as the European Robin, and crocodiles e. g. Saltwater Crocodile. These groups share the behaviours of nest-building, parental care of young, and ‘ singing’ to defend territory and attract mates. These behaviours were inherited from a common ancestor – fossils of dinosaurs, from which both birds and crocodiles are thought to have evolved from, have been found nesting with their young (Gishlick (Horner and Makela, 1979; Horner, 1982; Clark et al., 1999)).

An example of an analogous behaviour is the ability of tortoises e. g. Galápagos Giant Tortoise and hedgehogs e. g. Western European Hedgehog to draw into themselves when they feel threatened, however, they do this in a very different way. The hedgehog curls into a ball protecting its vulnerable

parts with its outer spines, and the tortoise retracts its vulnerable head, tail and feet into its protective shell made of bone (http://en. wikipedia. org/wiki/Gal%C3%A1pagos_tortoise). Hedgehogs are mammals and tortoises are reptiles are very distantly related so these species will not have inherited this behaviour from a shared ancestor that withdrew into itself. As they exhibit the same behaviour but achieve it by a different method this behaviour can be described as analogous (http://en. wikipedia. org/).

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