Activity

Mystery Long Bones

Examine the bones from these mystery animals and identify features that provide clues to their lifestyle and identify. Follow each link to see 3D models of the main long bones for each species. Identify each bone and then look for differences in proportion and in the size and shape of the joints.

Double click on the 3D models to change the rotation centre so that you can examine features of interest.

Mystery Animal A
Mystery Animal B
Mystery Animal C
Mystery Animal D
Mystery Animal E
Mystery Animal F
Mystery Animal G
Mystery Animal H

Hints:

- Robust bones with large muscle attachment areas indicate a powerful animal that uses its limbs for tasks that require strength - like digging.
- Long slender bones with smaller muscle attachments indicate an animal where speed is more important than power.
- The shape of the radius tells us a lot about how an animal uses its forearms. A round proximal end (at the elbow) indicates that the bone is able to rotate as the wrist moves from pronation to supination. If the radius is curved, this allows extreme movement as the radius can bend around the ulna as the hand rotates.
- How are the limbs proportioned? Are the upper limb bones (humerus and femur) the same length as the lower limb bones (radius/ulna and tibia/fibula)? What effect would this have on the lever action of these limbs?
- Are the fore and hind limbs the same length? For cursorial quadrupeds, the limbs must be similar in length. But this may not be the case for species that use their forelimbs for more specialised tasks, like digging, climbing or swimming.
- Also examine and compare the limbs of Koalas and Wombats in this direct comparison: https://skfb.ly/6VPq9

Answers

Mystery Animal A
https://sketchfab.com/3d-models/mystery-animal-a-cd72767d532344a1a976d70dca9a5099
Species: Common Wombat (*Vombatus ursinus*)
Specimen Number: MUVU2 (Monash University Anatomy Teaching Collection)
Source: Specimen scanned and provided by Hazel Richards.

- Bone 1: Radius
- Bone 2: Femur
- Bone 3: Ulna
- Bone 4: Tibia
- Bone 5: Humerus
- **NO Bone 6: MISSING FIBULA**

Diagnostic Features:

- Limb proportions - Upper and lower parts of each limb approximately equal length. Bones are stocky and robust. Indicates no cursorial adaptations.
- Humerus + ulna have very large muscle attachment processes (distal humerus, olecranon process of ulna) - large and powerful forelimb muscles. Indicates use of forelimb in something demanding other than walking. In this case, this indicates fossoriality, but these can also be features of aquatic animals that use the forelimb in swimming.
- Femur also has large muscle attachments and big distal articular surface at the knee - for bracing and supporting the body weight of a stocky animal while the forelimbs dig
- Head of the radius is pretty round - The forearm is able to pronate and supinate pretty well (but compare to animal B). Indicates use of hands to manipulate their environment (in this case digging).

Mystery Animal B
https://sketchfab.com/3d-models/mystery-animal-b-7fb4ed0d9aa640f5adf47e7bef12480f
Species: Koala (*Phascolarctos cinereus*)
Specimen Number: SAMM21451 (South Australian Museum)
Source: Scanned and provided by Hazel Richards.

- Bone 1: Ulna
- Bone 2: Femur
- Bone 3: Radius
- Bone 4: Humerus
- Bone 5: Tibia
- **NO Bone 6: MISSING FIBULA**

Diagnostic Features:

- Limb proportions - Bones are elongate and slender. Long limbs indicate increased reach might be important. Also weight-saving?
- Femur and humerus have big rounded heads - Indicates lots of shoulder and hip flexibility and mobility, for movement in a 3D environment
- Radial head is very rounded and shaft is is very bowed - for lots of pronation-supination freedom, indicates very dynamic use of the hand. (Extra info: this bowing also increases the attachment surface area in between the radius and ulna shafts for deep flexors of the fingers, indicates particular adaptation to grasping)

Mystery Animal C
https://sketchfab.com/3d-models/mystery-animal-c-44122132061741e88c05dd94dee299ec
Species: Marsupial Mole (*Notoryctes typhlops*)
Specimen Number: UMZC M37185-68258 (University Museum of Zoology, Cambridge, United Kingdom)
Source: Accessed via MorphoSource (Link: https://www.morphosource.org/Detail/SpecimenDetail/Show/specimen_id/19907)
MorphoSource Identifier: S19907

- Bone 1: Femur
- Bone 2: Fibula
- Bone 3: Tibia
- Bone 4: Radius
- Bone 5: Humerus
- Bone 6: Ulna

Diagnostic Features:

- Limb proportions - proximal elements (humerus and femur) are longer than distal elements (especially humerus:radius), indicates adaptations for powerful movements. Bone shapes are extremely modified. Indicates highly specialised locomotion.
- Massive expansion of distal humerus, olecranon process of the ulna, and proximal tibia. These are for attachment of huge muscles that very powerfully flex the wrist/fingers and ankles, indicating use of the hands and feet in high-resistance activity (i.e. digging)
- Big rounded heads of the humerus and femur, indicate shoulder and hip mobility are important.

Mystery Animal D
https://sketchfab.com/3d-models/mystery-animal-d-7f019d9bda6847adb510ec727f1fdb5b
Species: Tasmanian Devil (*Sarcophilus harrisii*)
Specimen Number: SAMM1944 (South Australian Museum)
Source: Scanned and provided by Hazel Richards.

- Bone 1: Fibula
- Bone 2: Tibia
- Bone 3:Ulna
- Bone 4: Radius
- Bone 5: Humerus
- Bone 6: Femur

Diagnostic Features:

- Limb proportions intermediate, suggests ‘generalised’ limb use.
- Radius with rounded head indicates a little pro-supination, but shaft is straight so not a lot. Suggests limited use of hands in non-locomotor activity.
- Distal humerus fairly narrow, with elbow joint surface deeply ‘trochleated’ (deep furrow between the articular condyles), olecranon of ulna pretty short - indicates mostly flexion-extension movements of the elbow, with good stability in this movement.

Mystery Animal E
https://sketchfab.com/3d-models/mystery-animal-f-8cc3d6f60e77411bb138956cd36064b8
Species: Wolverine (*Gulo gulo*)
Specimen Number: AMNH22884 (American Museum of Natural History)
Source: Scanned and provided by Hazel Richards.

- Bone 1: Ulna
- Bone 2: Radius
- Bone 3: Tibia
- Bone 4: Femur
- Bone 5: Humerus
- **NO Bone 6: MISSING FIBULA**

Diagnostic Features:

- Comments much the same as for Animal D, except radial head is NOT round, indicating hand use in non-locomotor activity was more limited.
- Limb proportions intermediate, suggests ‘generalised’ limb use, but quite robust so a stocky animal.
- Radius with rounded head indicates a little pro-supination, but shaft is straight so not a lot. Suggests limited use of hands in non-locomotor activity.
- Distal humerus fairly narrow, with elbow joint surface deeply ‘trochleated’ (deep furrow between the articular condyles), olecranon of ulna pretty short - indicates mostly flexion-extension movements of the elbow, with good stability in this movement.

Mystery Animal F
https://sketchfab.com/3d-models/mystery-animal-g-7b81ab4b8c064ae6812a1a60035c0cec
Species: Aardvark (*Orycteropus afer*)
Specimen Number: AMNH119504 (American Museum of Natural History)
Source: Scanned and provided by Hazel Richards.

- Bone 1: Humerus
- Bone 2: Radius
- Bone 3: Fibula
- Bone 4: Tibia
- Bone 5: Ulna
- Bone 6: Femur

Diagnostic Features:

- Comments much the same as for Animal A.
- Limb proportions - Upper and lower parts of each limb approximately equal length. Bones are stocky and robust. Indicates no cursorial adaptations.
- Humerus + ulna have very large muscle attachment processes (distal humerus, olecranon process of ulna) - large and powerful forelimb muscles. Indicates use of forelimb in something demanding other than walking. (Extra info: in this case indicates fossoriality, but these can also be features of aquatic animals that use the forelimb in swimming!)
- Femur also has large muscle attachments and big distal articular surface at the knee - for bracing and supporting the body weight of a stocky animal while the forelimbs dig
- Head of the radius is pretty round - The forearm is able to pronate and supinate pretty well (but compare to animal B). Indicates use of hands to manipulate their environment (in this case digging).
- Distal radius joint surface forms a curved socket, limiting movement to a single plane and stabilising the wrist in flexion-extension against high forces (use of the hand to scoop/dig)
- Additional distal muscle attachments on the femur - indicates powerful hindlimb muscles stabilising and supporting body weight while forelimbs are off the ground (~bipedal, but not upright - the back legs take the weight while the forelimbs do the digging. This is normally accompanied by a large tail that acts as a cantilever as balance)

Mystery Animal G
https://sketchfab.com/3d-models/mystery-animal-h-922842158be848a2bf5fe99dd589736c
Species: Tasmanian tiger (*Thylacinus cynocephalus*)
Specimen Number: NHMUK 1963.8.30.1 (Natural History Museum UK)
Source: Scanned and provided by Douglass Rovinsky.

- Bone 1: Femur
- Bone 2: Radius
- Bone 3: Humerus
- Bone 4: Ulna
- Bone 5: Tibia
- **NO Bone 6: MISSING FIBULA**

Diagnostic Features:

- Bones long and slender, more adapted for speed than power
- Distal humerus very narrow and joint surface highly trochleated - Limits and stabilises elbow movement in flexion-extension only. No attachment for big wrist and finger muscles, so not using the forelimb for anything other than locomotion (i.e. cursorial)
- Radial head not round, so pronation-supination not possible. Not using the hand for much non-locomotor activity.

Mystery Animal H
https://sketchfab.com/3d-models/mystery-animal-i-a986005d8c5a45fb9140afdc3e3999e9
Species: Painted wolf (*Lycaon pictus*)
Specimen Number: SMNS Z-MAM 006097 (State Museum of Natural History Stuttgart (German: *Staatliches Museum für Naturkunde Stuttgart*)
Source: Scanned and provided by Douglas Rovinsky.

- Bone 1: Ulna
- Bone 2: Humerus
- Bone 3: Tibia
- Bone 4: Femur
- Bone 5: Radius
- **NO Bone 6: MISSING FIBULA**

Diagnostic Features:

- Bones long and slender, more adapted for speed than power.
- Distal humerus very narrow and joint surface highly trochleated - Limits and stabilises elbow movement in flexion-extension only.
- No attachment for big wrist and finger muscles, so not using the forelimb for anything other than locomotion (i.e. cursorial)
- Radial head not round, so pronation-supination not possible. Not using the hand for much non-locomotor activity.